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Automatische Sprachverarbeitung

Leipzig Corpus Miner

A Text Mining Infrastructure for Qualitative Data Analysis

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Introduction

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- Humanists, social scientists and media analysts working with text as primary data have been opening up to large scale text analysis procedures
- Users lack a computer science background
- NLP experts lack background knowledge about requirements of social science research

- Leipzig Corpus Miner (LCM) builds a broad set of methods to perform content analysis (CA) tasks in large corpora
  - CA users need to express / formalize their requirements
  - NLP experts need to understand information needs of users
- LCM provides NLP analysis procedures, algorithms and visualizations

Introduction

Automatische Sprachverarbeitung

So where is the difference?

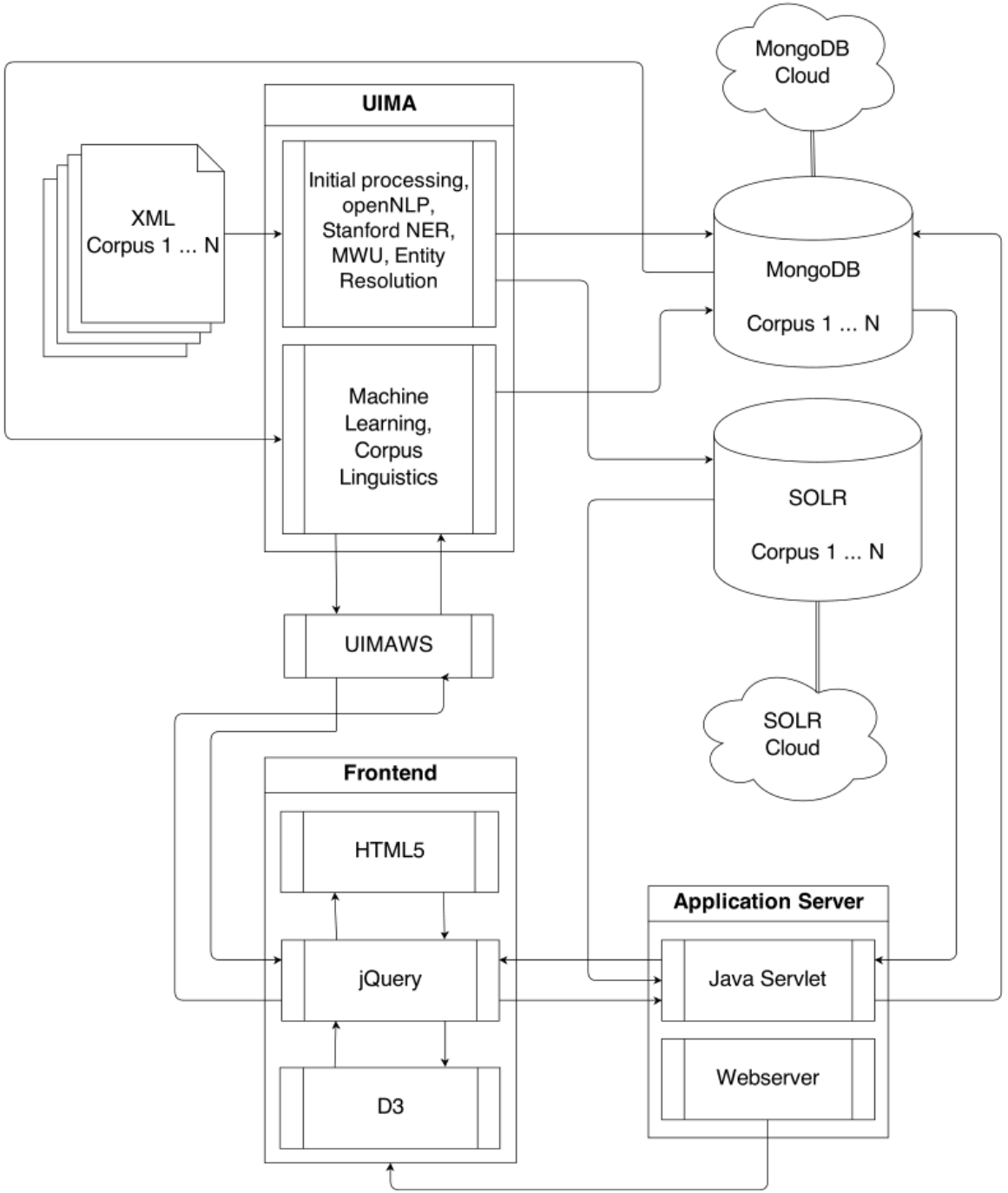
- NLP experts provide infrastructure: set of tools which enable analysts to support certain steps of an applied method and to extend the size of collections under investigation to a degree which could not be handled manually
  - Rather than apply a certain method or static limited workflow the LCM can be used to compile workflows from a set of algorithms and their result presentation
  - Where other computer assisted CA studies only apply one or just a few methods LCM allows for *integrated* application of multiple procedures
  - Separation of the computer science view from the users view
- humanists retain control over procedures
  - control of data selection, workflows and parameters
  - support of theory-led and exploratory research by supervised and unsupervised procedures

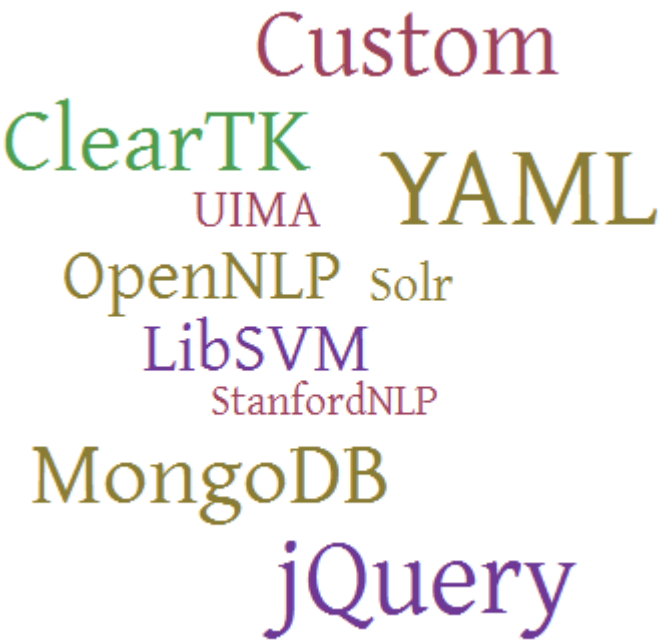
Architecture

Automatische Sprachverarbeitung

- LCM is a combination of different technologies to make qualitative data analysis accessible by an interface for people who are unfamiliar with NLP
- The methodological understanding of the users is focused.
- The technical issues are hidden.
- To solve this requirement we need to address the following tasks:
  - Data storage
  - Retrieval
  - Machine Learning / NLP
  - Presentation

Architecture





Architecture

Automatische Sprachverarbeitung

- Text Mining: Central objective of the LCM is to enable analysts to perform computational text analysis without explicit guidance by NLP experts
  - user-friendly web application
  - analysis workflows specific to methodological requirements
- UIMAWS middleware:
  - processes can be executed, stopped and managed by the users – computational expensive operations in the background
- Data management:
  - Users work on collections which are subselections of all documents stored in a corpus
  - results of analysis procedures stored per collection / user → may be used as input resources for further steps

Analysis capabilities

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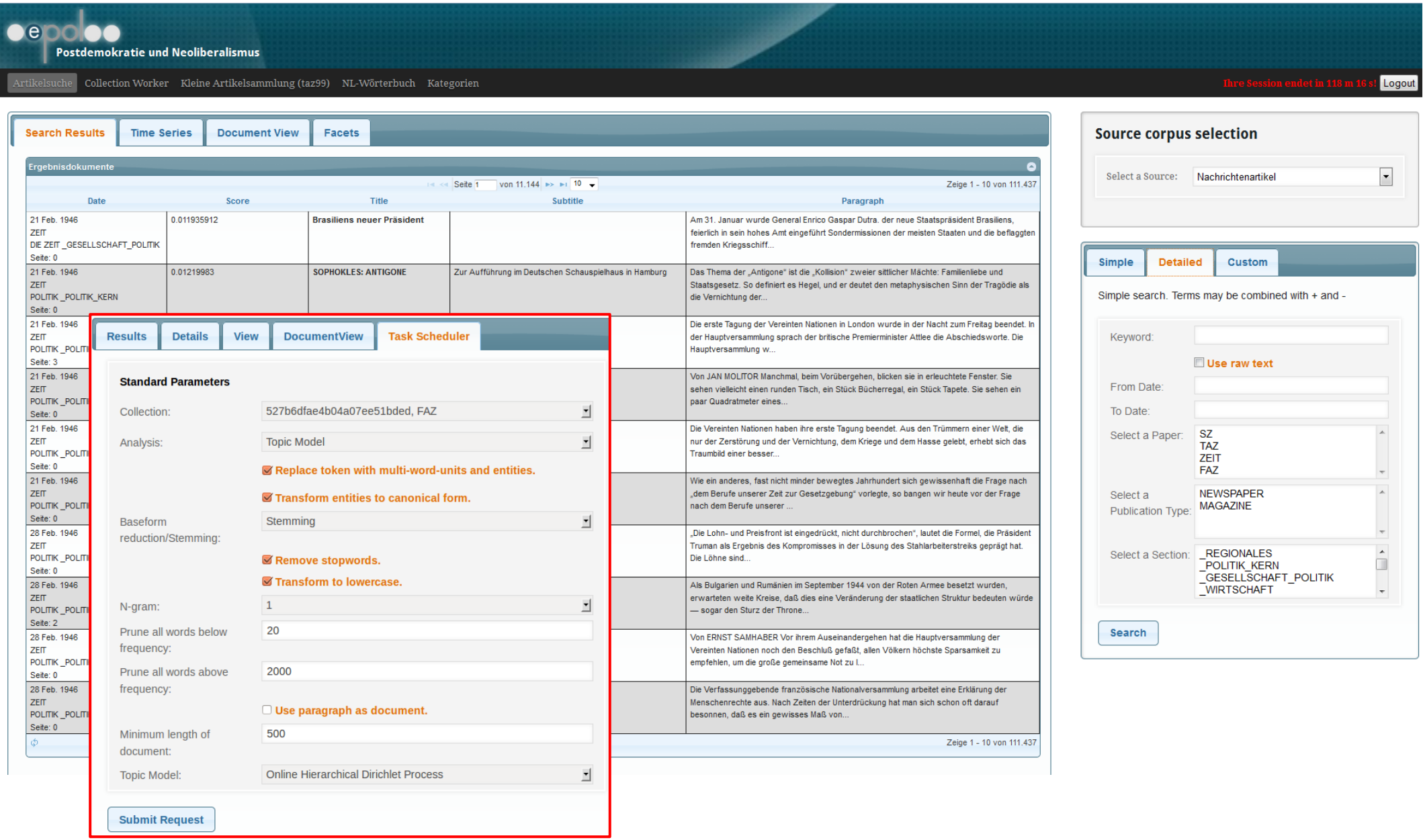
- **Information Retrieval**
  - Full text index
  - Contextualized dictionaries which can be retrieved from a reference corpus of paradigmatic documents
  - Retrieved documents can be stored as collections
  - Collections can be refined (removing, adding of documents)
- **Lexicometrics**
  - Frequency analysis
  - Co-occurrence analysis (different significance measures)
  - Automatic extraction of key terms

User-interface

ASV Automatische Sprachverarbeitung



Analysis capabilities

Automatische Sprachverarbeitung

epoloo
Postdemokratie und Neoliberalismus

Artikelsuche | Collection Worker | Kleine Artikelsammlung (taz99) | NL-Wörterbuch | Kategorien

Results | Details | View | DocumentView | Task Scheduler

Select cooccurrence view:

>Reset Chart<

Display Type
graph

Cooccurrence Type
directed

Cooccurrence Significance
Log-Likelihood

Invert X Initialization.

Invert Y Initialization.

Root max Links:
7

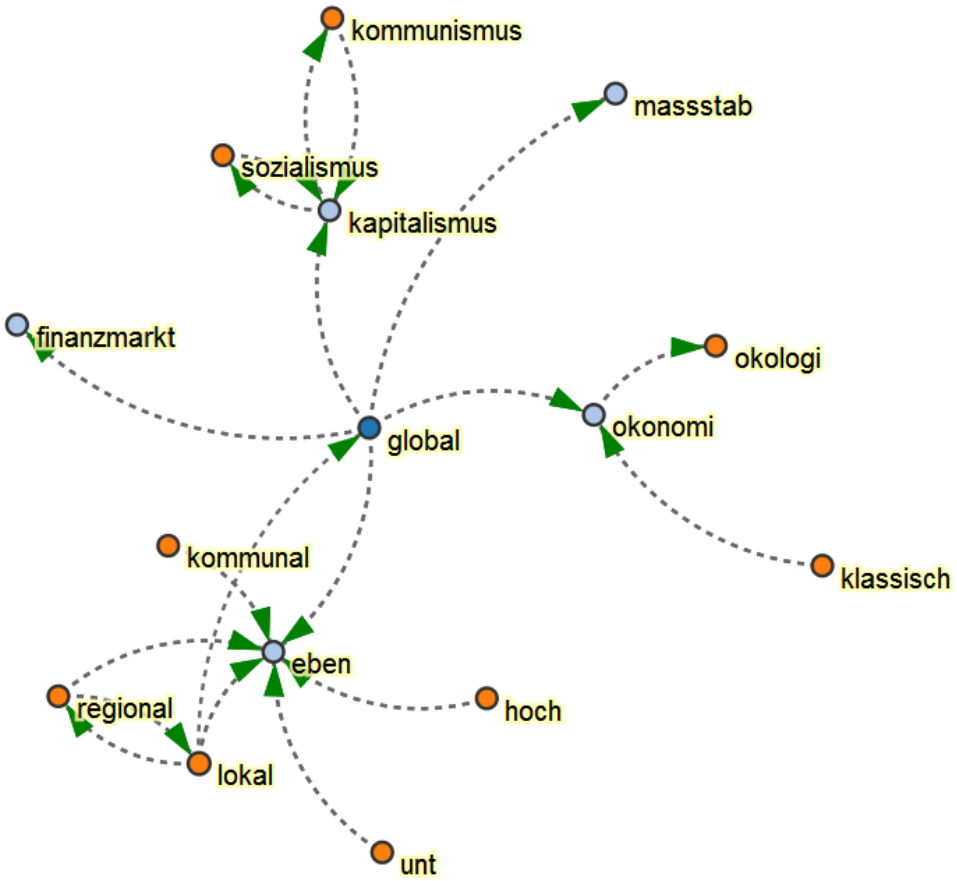
Leaves max Links:
7

Graph Force:
0

>Load Words<

Type to filter

(kommunist), 1846
(organisation), 1843
(mitglied), 1840
(best), 1837
(zusatz), 1832
(global), 1818
(konservativ), 1812



Collecti

Import

Analysis capabilities

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Results | Details | View | DocumentView | Task Scheduler

Term Extraction Result

Seite 1 von 4 — Zeige 1 - 25 von 96

Wordform	Pitman-Yor Weight
schwarz	0.05251332927826234
steuerreform	0.04104232258294118
armut	0.040581085075405164
wirtschaftspolitik	0.037536447784544284
konservativ	0.0890054032650477
großbritannien	0.07330368722464492
familie	0.02555741217025264
stadt	0.0327194282984891
regierungen	0.04507211646803578
natur	0.036788306817679105
euro	0.10359476908453702
wahlen	0.02126337353003894
koalition	0.033774624420120615
frauen	0.04028180934580125
konjunktur	0.022515109104455075
theorie	0.05519041007823491
umwelt	0.06031665466422563
interesse	0.018841952749104107
europäischen	0.031574558859018956
spd	0.09099110584538517
energie	0.04339872022388537
china	0.06585250516412187
arbeitnehmer	0.055637593895247646
kultur	0.028125689030592517
...	0.015276187522327211

Download — Seite 1 von 4 — Zeige 1 - 25 von 96

Click another term or generate new examples by clicking term again.

1. , Wirtschaftssprecher der Labour-Fraktion, stieß denn auch in die verwundbarste Stelle, nämlich die Fähigkeit der Thatcher-Regierung, die **Konjunktur** sicher und stetig zu steuern. „Das wirkliche Wirtschaftswunder", höhnte | **Document: 50e4129be4b09f954b7984a9 | Source:articles**

2. Dagegen die Europäische Union: Regierungen und Ökonomen bezweifeln, dass sich Europas **Konjunktur** aus eigener Kraft erholt. Sie setzen ausgerechnet wieder auf die USA, deren Aufschwung | **Document: 50ddb82ae4b09f954b73d9b9 | Source:articles**

3. Heute muss die **Konjunktur** als Entschuldigung für politische Passivität herhalten. Ein Aufschwung wie der aktuelle ist willkommenes Valium für die Bundesregierung. Mehr als zwei Prozent | **Document: 51d4082fe4b09a55c10807d6 | Source:articles**

4. Andererseits hat die Diskussion um die Gemeingüter gerade **Konjunktur**: Der Bankrott des neoliberalen Denkmodells führt zur Besinnung auf traditionelle Werte, das ungeahnte Tempo | **Document: 5093d914e4b04fe27ff295a3 | Source:articles**

5. vorgesehen. Außerdem hat die Bank von Japan schon im Frühjahr die Leitzinsen gesenkt und damit auch von der monetären Seite her die Voraussetzungen für ein Wiederanziehen der **Konjunktur** geschaffen. Rechtzeitig | **Document: 50a751d4e4b079434e09f8a3 | Source:articles**

6. In der Politik hat das Wort „Zumutung" ja gerade **Konjunktur**. Was würden Sie Ausländern zumuten, damit sie ihren Teil zur Integration beitragen? | **Document: 50929adee4b04fe27fef9ee5 | Source:articles**

Analysis capabilities

Automatische Sprachverarbeitung

- **Topic Models** (Topic Models are statistical models which infer probability distributions over latent variables, assumed to represent topics, in text collections as well as in single documents - e.g. LDA, Blei et. al 2003)
  - Unsupervised clusters of topics
  - Retrieve documents for different topics
  - Topic time series analysis
- **Classification**
  - Creation of hierarchical category systems
  - Annotation of training data of different granularity (Paragraph, Sentence, Document).
  - Multiple Labels can be assigned to a annotation
  - Usage of different classification algorithms (libSVM, Naive Bayes)
  - Features on lexical and syntactical level are used

Analysis capabilities

Automatische Sprachverarbeitung

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Postdemokratie und Neoliberalismus

Artikelsuche | Collection Worker | Kleine Artikelsammlung (taz99) | NL-Wörterbuch | Kategorien

Results | Details | View | DocumentView | Task Scheduler

Select graph resolution

>Reset Chart<

Year

Document Count

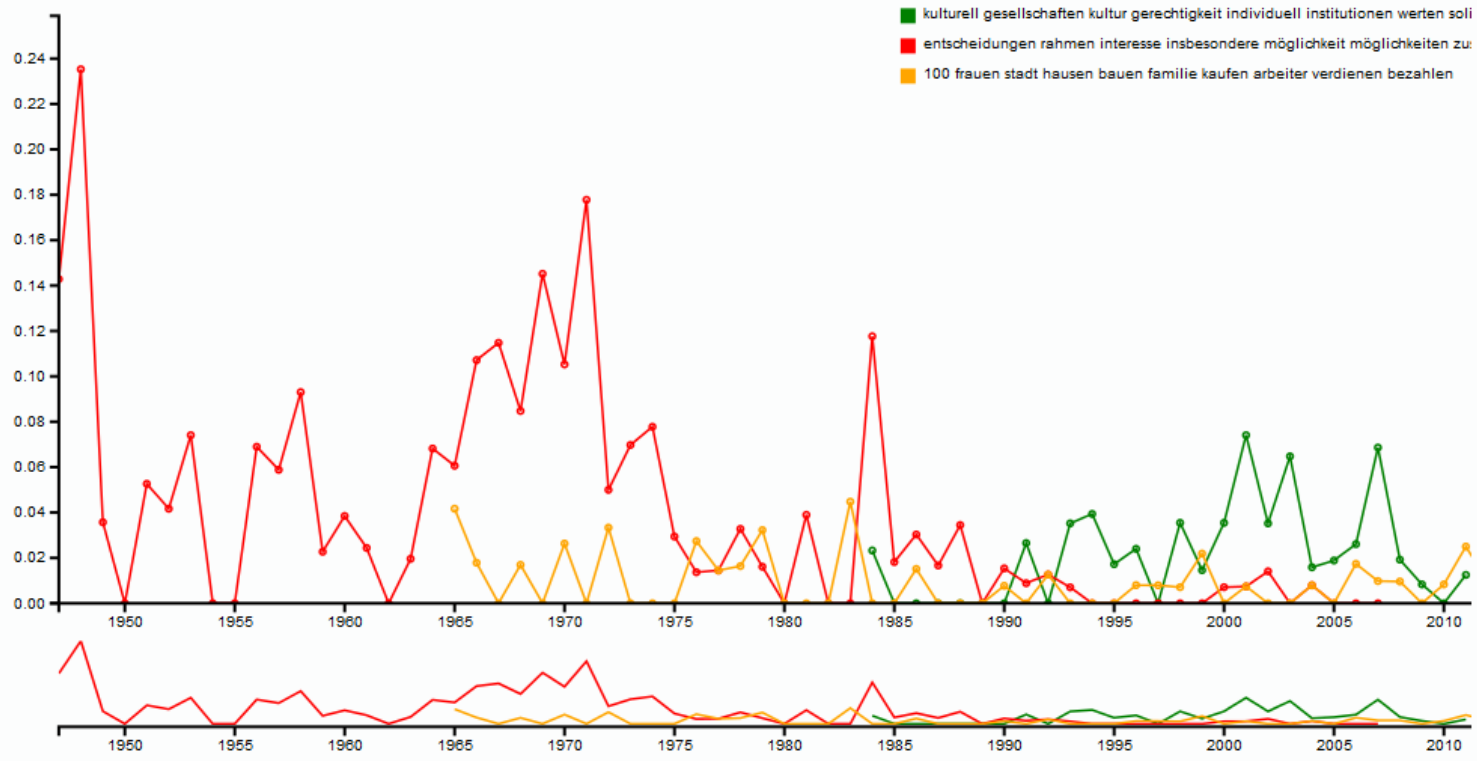
relative (Collection)

minProbability: 0.5

Probability: 0.1278
moralisch mensch kriegen wort ... meinung geschehen wahrheit schreiben intellektuell

Probability: 0.1273
entscheidungen rahmen interesse insbesondere möglichkeit möglichkeiten zusammenhang entscheidung beteiligen ergeben

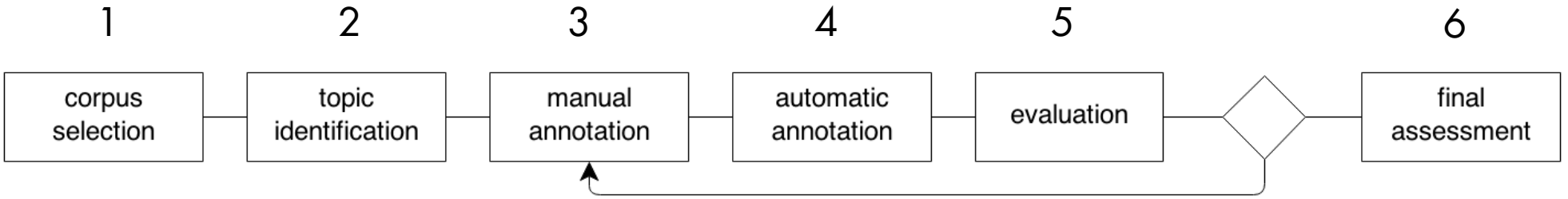
Probability: 0.0734
kulturell gesellschaften kultur gerechtigkeit individuell in



Analysis capabilities

Use Case

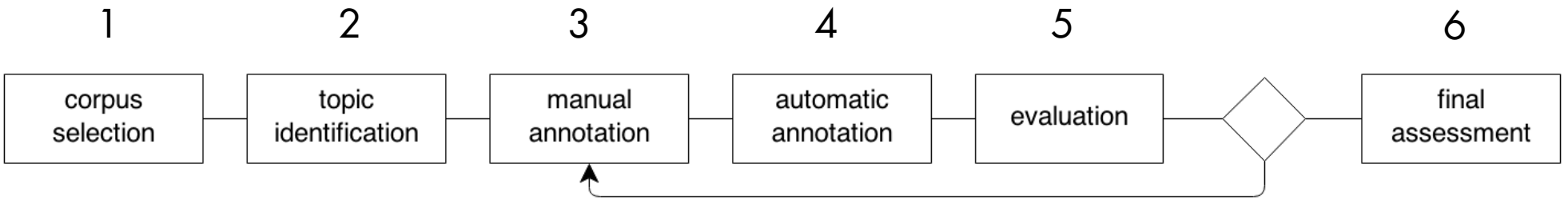
- Content Analysis study on “Neoliberalism” by political theorists
- Social science objective: identify changes in discursive patterns of policy justifications in public media
- a corpus consisting of 3.5 million German newspaper articles from 1946 to 2012 is investigated
- (simplified) workflow realized with the LCM



Use Case

- 1) Select a subset of relevant documents
  - Using documents of themes and modes that reflect the research question to formulate key terms and co-occurrence patterns
  - On this basis a set of 10.000 documents was retrieved from the data source to formulate an initial collection (Wiedemann/Niekler 2014)

- 2) Topic Model processing on the set of 10.000 documents
  - Identification of thematic clusters (policy fields)
  - Identification of irrelevant topics and documents



Use Case

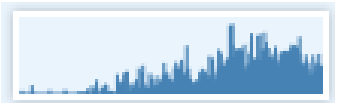
Automatische Sprachverarbeitung

score	length	year	title	
347,22	685	1977	Pro und kontra Mehrwertsteuer	[Pro's and con's of VAT]
321,81	662	1973	Oelkrise und Konjunktur	[Oil crisis and economy]
290,48	705	1966	Energie muß billig sein	[Energy has to be cheap]
289,34	687	1977	Die Steuern senken	[Lower the taxes]
287,26	845	1964	Korrektur der Einkommensteuer	[Correction of VAT]
281,07	687	1971	Die Bauern im Nacken	[The farmers at the neck]
279,74	884	1965	Was ist uns die Mark wert?	[What is the „Mark“ worth to us?]
272,75	682	1970	Steuern mit der Steuer	[Governing with taxes]
264,82	719	1971	Ohne Abkühlung keine Stabilität	[No stability without slowdown]
262,81	671	1973	Das sicherste Mittel	[The most secure instrument]
261,33	707	1972	Entlastung – wovon?	[Relief – of what?]
254,97	676	1979	Das Fernsehen und die Angst	[Television and fear]
254,93	704	2011	Nicht ernst gemeint: die Quote	[Quotas not meant serious]
251,53	457	1977	Eine Konfliktstrategie der Union	[A conflict strategy of the EU]
250,46	638	2010	Die neue Auflehnungsbereitschaft	[The new willingness for rebellion]

Use Case

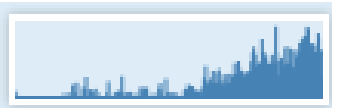
Automatische Sprachverarbeitung

kulturell, 0.0048
gesellschaften, 0.0040
kultur, 0.0038
gerechtigkeit, 0.0037
individuell, 0.0034
institutionen, 0.0032
werten, 0.0031
solidarität, 0.0030
globalisierung, 0.0029
kollektiv, 0.0029
gleichheit, 0.0025
moralisch, 0.0024
alternativ, 0.0023

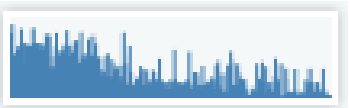


nachfragen, 0.0051
wirtschaftspolitik, 0.0051
löhnen, 0.0048
bundesbank, 0.0036
konjunktur, 0.0034
zinsen, 0.0033
bundesregierung, 0.0030
steigend, 0.0030
unternehmer, 0.0029
rezession, 0.0030
stabilität, 0.0029
währung, 0.0029
real, 0.0028

märken, 0.0072
global, 0.0069
euro, 0.0058
banken, 0.0057
globalisierung, 0.0056
regeln, 0.0045
weltweit, 0.0042
ökonomen, 0.0041
kapital, 0.0039
regierungen, 0.0036
schulden, 0.003454
kapitalismus, 0.003497
finanzmärkte, 0.0031

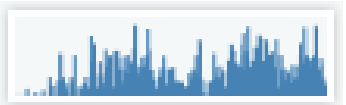


landwirtschaft, 0.0067
industrie, 0.0041
bauern, 0.0039
verbraucher, 0.0031
landwirtschaftlich, 0.0028
erheblich, 0.0028
industriell, 0.0027
gesamt, 0.0025
kaufen, 0.0025
betragen, 0.0023
agrarpolitik, 0.0022
höhen, 0.0020
nachfragen, 0.0020



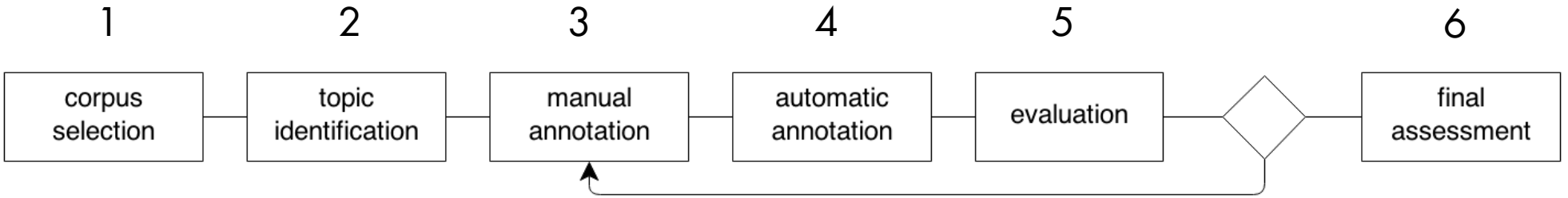
wissenschaft, 0.0083
wissenschaftlich, 0.0068
medien, 0.0045
fernsehen, 0.0041
informationen, 0.0037
computer, 0.0037
forschung, 0.0035

wissenschaftler, 0.0034
Information, 0.0034
genetisch, 0.0033
kulturell, 0.0033
internet, 0.0033
mensch, 0.0027
kultur, 0.0025



Use Case

- 3) Annotation of training data
  - The document set of 10.000 is a list ranked by relevancy
  - → select most relevant articles per topic for manual annotation
  - political scientists argumentative structures in newspaper articles (annotation with hierarchical category systems developed for this task)
  - Relevant parts in the documents are annotated
- 4) Automatic classification
  - An automatic classification procedure is invoked on the unlabeled data to identify more text parts containing argumentative structures. The NLP group supports the analysts by identifying discriminating linguistic features.



Use Case

Automatische Sprachverarbeitung

- Example category schema
  - Paragraph with argumentation
    - Claim
    - Argument
      - Date
      - Reasons
      - Marker
      - Conclusion
  - Bias
    - critically
    - Affirmative
  - Type
    - Not relevant
    - Meta
    - Text with topic

Examples for category Bias - affirmative

Wer vom Ertrag seiner Arbeit nicht leben kann, sollte eine Steuergutschrift bekommen – das hilft mehr als ein Mindestlohn

Those who can not live off the proceeds of his labor, should get a tax credit - which helps more than a minimum wage

Die Sozialpolitik braucht neue Methoden Das Prinzip der Bevormundung ist mit der freien Ordnung unvereinbar

Social policy needs new methods, the principle of paternalism is incompatible with the free order

Weitere Steuererhöhungen scheinen kaum noch tragbar, viel eher müßte die Steuerbürde vermindert werden. Besonders notwendig wäre eine Milderung offenkundiger Härten bei der Lohnsteuer und bei der Besteuerung kleiner Unternehmen.

More tax increases seem hardly portable, much more the tax burden would be reduced. Particular need would be a mitigation of manifest hardship on the payroll tax and the taxation of small businesses.

Use Case

Automatische Sprachverarbeitung

Examples for automatic classification

Unter reinen Marktbedingungen sind Bildungs-, Gesundheits-, und Pflegedienstleistungen für viele nicht bezahlbar.

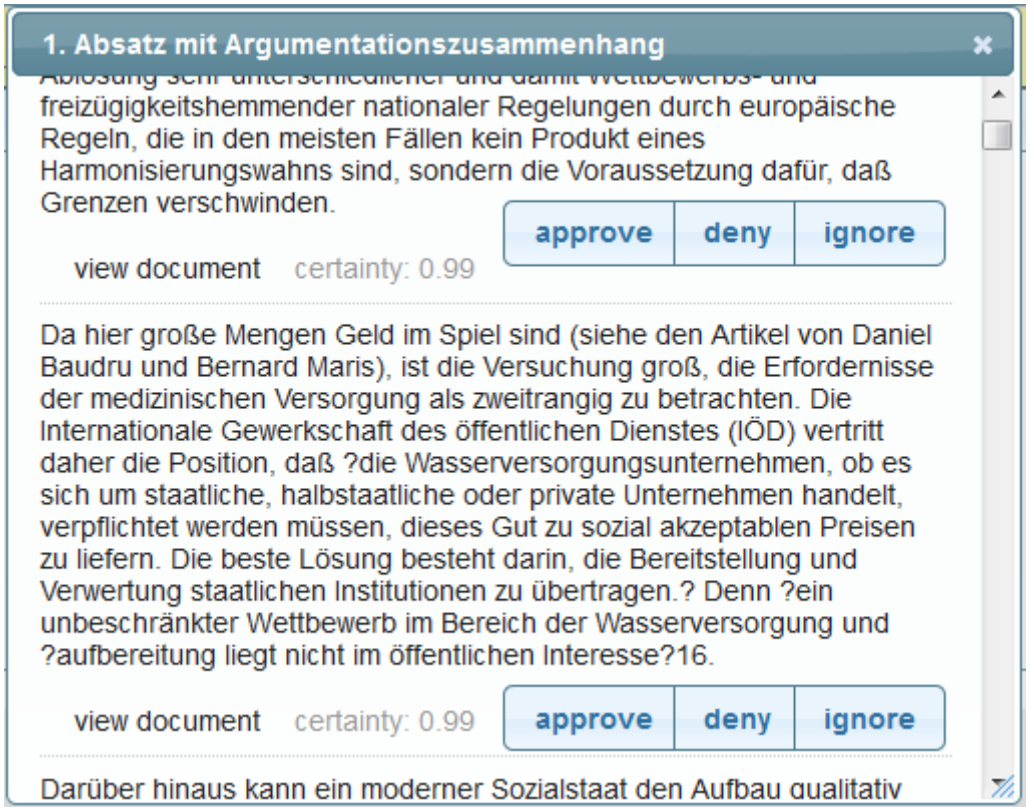
Under pure market conditions educational, health, and care services is not affordable for many.

… dass der Staat stets der schlechtere Akteur am Markt und deshalb außerstande ist, die Geschicke privater Unternehmen, namentlich von Banken zu leiten?

…that the state is always the worse player on the market and therefore is incapable of the fortunes of private enterprises, particularly to lead by banks?

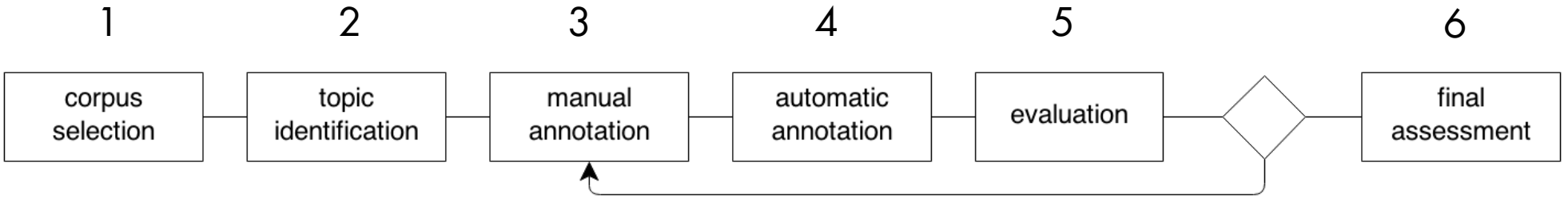
Klar ist auch, daß die Chancen für den selbständigen Unternehmer abnehmen, wenn sich der Staat im Unternehmenssektor auf Kosten, der Privaten ausdehnt.

It is also clear that the opportunities for self-employed entrepreneurs decrease as the state expands in the corporate sector at the expense of the entrepreneurs



Use Case

- 5) Classification review
  - Text snippets identified in the previous step (supposedly containing arguments of interest) are presented to the analysts ranked by certainty of label assignments.
  - Analysts can verify or reject the results manually.
  - In this active learning paradigm we calculate internal precision / recall measures while the analysts are evaluating the process qualitatively. If those ongoing evaluations show satisfactory results, the process of creating training data is concluded.
- 6) Rerun classification task with corrected results on entire collection
  - The classification procedure is run on the entire collection under investigation.
  - Results can be described qualitatively and quantitatively (e.g. proportions of categories over time slices).



Conclusion

Automatische Sprachverarbeitung

- The LCM supports manual Content Analysis (CA) via basic corpus linguistic procedures as well as supervised state-of-the-art Text Mining techniques
- The methods can be used separately and independently
- It reflects the diversity of CA instead of providing a static predefined processing

- Extensions
  - Our target is to integrate more methods for semantic analysis and changes over time
  - For the classification process we need to integrate more feature engineering methods
  - Scalability

References

1. Biemann, C., Heyer, G., Quasthoff, U., Richter, M.: *The leipzig corpora collection - monolingual corpora of standard size*. In: Proceedings of Corpus Linguistics Conference (2007)

2. Blei, D.M.: *Probabilistic topic models: Surveying a suite of algorithms that offer a solution to managing large document archives.* Communications of the ACM 55(4), 77–84 (2012)

3. Blei, D.M., Ng, A.Y., Jordan, M.I.: *Latent dirichlet allocation*. Journal of Machine Learning Research 3, 993–1022 (2003)

4. Bostock, M., Ogievetsky, V., Heer, J.: *D3: Data-driven documents*. IEEE Trans. Visualization & Comp. Graphics (Proc. InfoVis) 17(4), 2301 – 2309 (2011)

5. Büchler, M.: Medusa: Performante Textstatistiken auf großen Textmengen: Kookkurrenzanalyse in Theorie und Anwendung (2008)

6. Burghardt, M., Wolff, C.: *Stand off-Annotation für Textdokumente: Vom Konzept zur Implementierung (zur Standardisierung?)*. In: Proceedings of the Biennial GSCL Conference. pp. 53–59 (2009)

7. Ferrucci, D., Lally, A.: *Uima: An architectural approach to unstructured information processing in the corporate research environment.* Nat. Lang. Eng. 10(3-4), 327–348 (2004)

8. Finkel, J.R., Grenager, T., Manning, C.: *Incorporating non-local information into information extraction systems by gibbs sampling*. In: Proceedings of the 43rd Annual Meeting on Association for Computational Linguistics. pp. 363–370 (2005)

9. Glaser, B.G., Strauss, A.L.: *Grounded theory: Strategien qualitativer Forschung* (2005)

10. Heyer, G., Holz, F., Teresniak, S.: *Change of topics over time and tracking topics by their change of meaning*. In: Proceedings of the International Conference on Knowledge Discovery and Information Retrieval. pp. 223–228 (2009)

11. Hoffman, M.D., Blei, D.M., Bach, F.R.: *Online learning for latent dirichlet allocation.* In: Neural Information Processing Systems (NIPS). pp. 856–864 (2010)

12. Krippendorff, K.: *Content analysis: An introduction to its methodology.* SAGE, 3 edn. (2013)

13. Laclau, E., Mouffe, C.: *Hegemony and socialist strategy*. Verso, 2 edn. (2001)

14. Lemke, M.: *Die Okonomisierung des Politischen: Entdifferenzierungen in kollektiven Entscheidungsprozessen.* Discussion Paper Nr. 2. Hamburg and Leipzig (2012), http://www.epol-projekt.de/discussion-paper/discussion-paper-2/

15. Lughofer, E.: *Hybrid active learning (hal) for reducing the annotation efforts of operators in classification systems*. Pattern Recognition 45(2), 884–896 (2012)

16. Mayring, P.: *Qualitative Inhaltsanalyse: Grundlagen und Techniken*. Beltz, 11 edn. (2010)

17. Niekler, A., Jähnichen, P., Heyer, G.: *ASV Monitor: Creating comparability of machine learning methods for content analysis.* In: Proceedings of the 2012 European Conference on Machine Learning and Knowledge Discovery in Databases – Volume Part II. pp. 812–815 (2012)

18. Ogren, P.V., Wetzler, P.G., Bethard, S.: *ClearTK: A UIMA toolkit for statistical natural language processing*. In: Towards Enhanced Interoperability for Large HLT Systems: UIMA for NLP workshop at Language Resources and Evaluation Conference (LREC). pp. 865–869 (2008)

19. Scharkow, M.: *Automatische Inhaltsanalyse und maschinelles Lernen*. Epubli, 1 edn. (2012)

20. Steinberger, R., Pouliquen, B., Kabadjov, M., Belyaeva, J., van der Goot, E.: *JRC-NAMES: A freely available, highly multilingual named entity resource.* In: Proceedings of the International Conference Recent Advances in Natural Language Processing. pp. 104–110 (2011)

21. Teh, Y.W., Jordan, M.I.: *Hierarchical Bayesian nonparametric models with applications*. In: Bayesian Nonparametrics. 1 edn. (2010)

22. Wiedemann, G.: *Opening up to big data: Computer-assisted analysis of textual data in social sciences*. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research 14(2) (2013)

23. Zhou, X., Zhang, X., Hu, X.: *Semantic smoothing for bayesian text classificationwith small training data*. In: Proceedings of the SIAM International Conference on Data Mining. pp. 289–300 (2008)