Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Alexander Panchenko

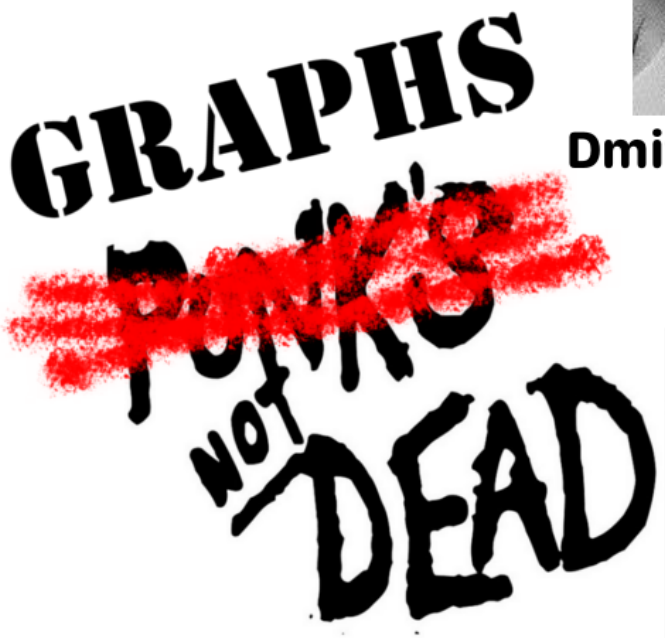
FROM UNSUPERVISED INDUCTION OF LINGUISTIC STRUCTURES FROM TEXT TOWARDS APPLICATIONS IN DEEP LEARNING

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

In close collaboration with ...

Chris Biemann

Dmitry 'Tsar' Ustalov



Stefano Faralli

Simone P. Ponzetto

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

In collaboration with ...

- **Andrei Kutuzov**
- **Eugen Ruppert**
- **Fide Marten**
- **Nikolay Arefyev**
- **Steffen Remus**
- **Martin Riedl**
- **Hubert Naets**
- **Maria Pelevina**
- **Anastasiya Lopukhina**
- **Konstantin Lopukhin**

Overview

Overview

- **Inducing word sense representations**:
  - **word sense embeddings via retrofitting** [Pelevina et al., 2016, Remus & Biemann, 2018];
  - **inducing synsets** [Ustalov et al., 2017b, Ustalov et al., 2017a, Ustalov et al., 2018b]
  - **inducing semantic classes** [Panchenko et al., 2018b]

Overview

- **Inducing word sense representations**:
  - **word sense embeddings via retrofitting** [Pelevina et al., 2016, Remus & Biemann, 2018];
  - **inducing synsets** [Ustalov et al., 2017b, Ustalov et al., 2017a, Ustalov et al., 2018b]
  - **inducing semantic classes** [Panchenko et al., 2018b]

- **Making induced senses interpretable** [Panchenko et al., 2017b, Panchenko et al., 2017c]

Overview

- **Inducing word sense representations**:
  - **word sense embeddings via retrofitting** [Pelevina et al., 2016, Remus & Biemann, 2018];
  - **inducing synsets** [Ustalov et al., 2017b, Ustalov et al., 2017a, Ustalov et al., 2018b]
  - **inducing semantic classes** [Panchenko et al., 2018b]

- **Making induced senses interpretable** [Panchenko et al., 2017b, Panchenko et al., 2017c]

- **Linking induced word senses to lexical resources** [Panchenko, 2016, Faralli et al., 2016, Panchenko et al., 2017a, Biemann et al., 2018]

Overview

- **A shared task on word sense induction**
  [Panchenko et al., 2018a, Arefyev et al., 2018]

Overview

- **A shared task on word sense induction**
  [Panchenko et al., 2018a, Arefyev et al., 2018]

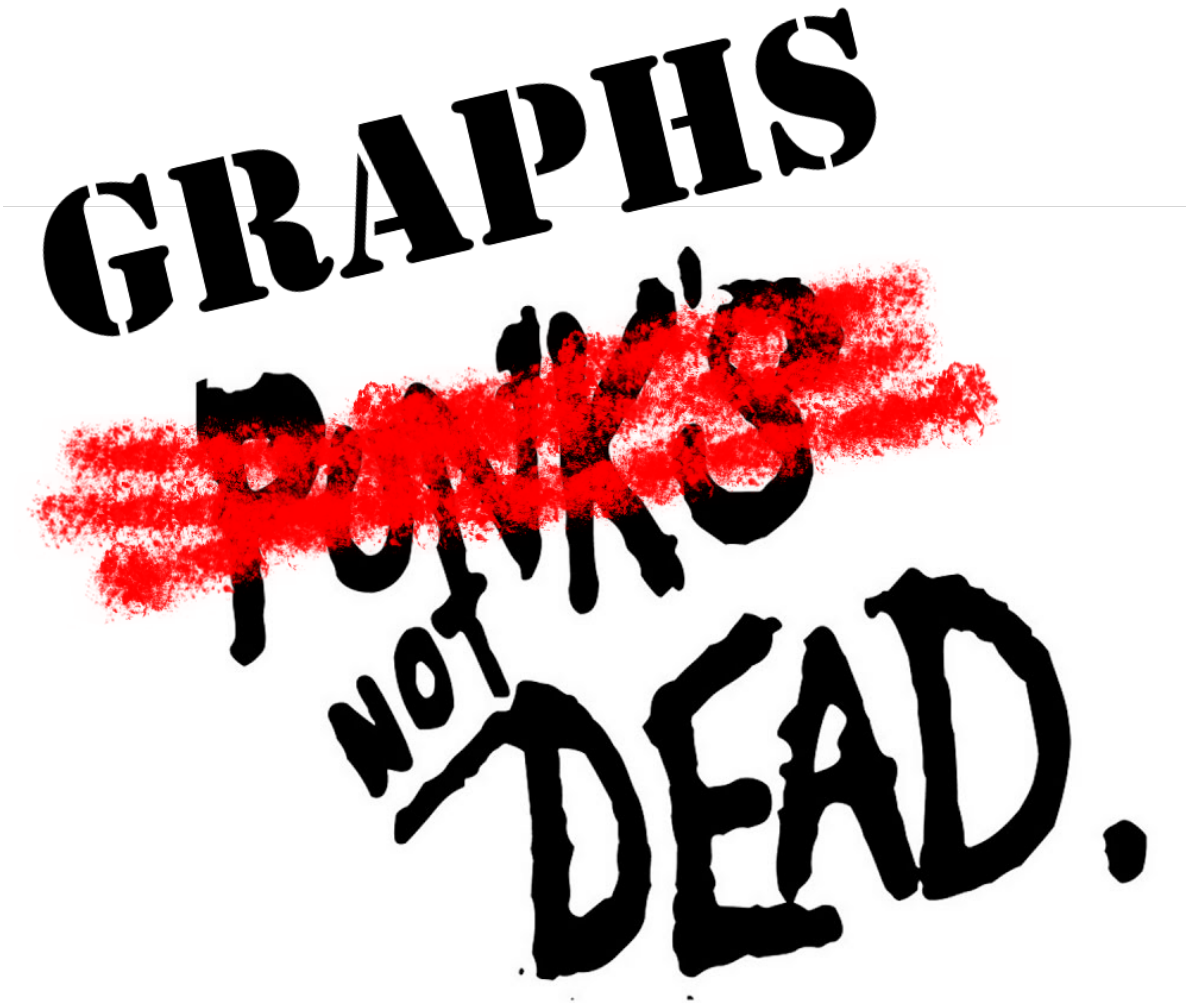
- **Inducing semantic frames** [Ustalov et al., 2018a]
  - Inducing **FrameNet**-like structures;
  - ...using **multi-way clustering**.

Overview

- **A shared task on word sense induction** [Panchenko et al., 2018a, Arefyev et al., 2018]
- **Inducing semantic frames** [Ustalov et al., 2018a]
  - Inducing **FrameNet**-like structures;
  - ...using **multi-way clustering**.
- **Learning graph/network embeddings** [ongoing joint work with Andrei Kutuzov]
  - How to **represent induced networks/graphs**?
  - ... so that they can be used in **deep learning architectures**.
  - ...**effectively** and **efficiently**.

Conclusion

Vectors + Graphs = ♡



Take home messages

- We can **induce word senses**, **synsets** and **semantic classes** in a knowledge-free way using **graph clustering** and **distributional models**.

Take home messages

- We can **induce word senses**, **synsets** and **semantic classes** in a knowledge-free way using **graph clustering** and **distributional models**.
- We can make the **induced word senses interpretable** in a knowledge-free way with **hypernyms**, **images**, **definitions**.

Take home messages

- We can **induce word senses**, **synsets** and **semantic classes** in a knowledge-free way using **graph clustering** and **distributional models**.
- We can make the **induced word senses interpretable** in a knowledge-free way with **hypernyms**, **images**, **definitions**.
- We can **link induced senses to lexical resources** to
  - improve **performance of WSD**;
  - **enrich lexical resources** with emerging senses.

Acknowledgments

Thank you! Questions?

This research was supported by

DFG Deutsche Forschungsgemeinschaft

DAAD Deutscher Akademischer Austausch Dienst
German Academic Exchange Service

Sense embeddings using retrofitting

Evaluation on SemEval 2013 Task 13 WSI&D:

Model	Jacc.	Tau	WNDCG	F.NMI	F.B-Cubed
AI-KU (add1000)	0.176	0.609	0.205	0.033	0.317
AI-KU	0.176	0.619	0.393	0.066	0.382
AI-KU (remove5-add1000)	0.228	0.654	0.330	0.040	0.463
Unimelb (5p)	0.198	0.623	0.374	0.056	0.475
Unimelb (50k)	0.198	0.633	0.384	0.060	0.494
UoS (#WN senses)	0.171	0.600	0.298	0.046	0.186
UoS (top-3)	0.220	0.637	0.370	0.044	0.451
La Sapienza (1)	0.131	0.544	0.332	–	–
La Sapienza (2)	0.131	0.535	0.394	–	–
AdaGram, α = 0.05, 100 dim	0.274	0.644	0.318	0.058	0.470
w2v	0.197	0.615	0.291	0.011	0.615
w2v (nouns)	0.179	0.626	0.304	0.011	0.623
JBT	0.205	0.624	0.291	0.017	0.598
JBT (nouns)	0.198	0.643	0.310	0.031	0.595
TWSI (nouns)	0.215	0.651	0.318	0.030	0.573


Arefyev, N., Ermolaev, P., & Panchenko, A. (2018).
How much does a word weigh? weighting word embeddings for word sense induction.
arXiv preprint arXiv:1805.09209.


Biemann, C., Faralli, S., Panchenko, A., & Ponzetto, S. P. (2018).
A framework for enriching lexical semantic resources with distributional semantics.
In *Journal of Natural Language Engineering* (pp. 56–64).: Cambridge Press.


Faralli, S., Panchenko, A., Biemann, C., & Ponzetto, S. P. (2016).
Linked disambiguated distributional semantic networks.
In *International Semantic Web Conference* (pp. 56–64).: Springer.


Panchenko, A. (2016).
Best of both worlds: Making word sense embeddings interpretable.
In *LREC*.

Panchenko, A., Faralli, S., Ponzetto, S. P., & Biemann, C. (2017a).
Using linked disambiguated distributional networks for word sense disambiguation.
In *Proceedings of the 1st Workshop on Sense, Concept and Entity Representations and their Applications* (pp. 72–78). Valencia, Spain: Association for Computational Linguistics.

Panchenko, A., Lopukhina, A., Ustalov, D., Lopukhin, K., Arefyev, N., Leontyev, A., & Loukachevitch, N. (2018a).
Russe'2018: A shared task on word sense induction for the russian language.
arXiv preprint arXiv:1803.05795.

Panchenko, A., Marten, F., Ruppert, E., Faralli, S., Ustalov, D., Ponzetto, S. P., & Biemann, C. (2017b).
Unsupervised, knowledge-free, and interpretable word sense disambiguation.
In *Proceedings of the 2017 Conference on Empirical Methods in Natural Language Processing: System Demonstrations* (pp.

91–96). Copenhagen, Denmark: Association for Computational Linguistics.

Panchenko, A., Ruppert, E., Faralli, S., Ponzetto, S. P., & Biemann, C. (2017c).
Unsupervised does not mean uninterpretable: The case for word sense induction and disambiguation.
In *Proceedings of the 15th Conference of the European Chapter of the Association for Computational Linguistics: Volume 1, Long Papers* (pp. 86–98). Valencia, Spain: Association for Computational Linguistics.

Panchenko, A., Ustalov, D., Faralli, S., Ponzetto, S. P., & Biemann, C. (2018b).
Improving hypernymy extraction with distributional semantic classes.
In *Proceedings of the LREC 2018* Miyazaki, Japan: European Language Resources Association.

Pelevina, M., Arefiev, N., Biemann, C., & Panchenko, A. (2016).
Making sense of word embeddings.

In *Proceedings of the 1st Workshop on Representation Learning for NLP* (pp. 174–183). Berlin, Germany: Association for Computational Linguistics.


Remus, S. & Biemann, C. (2018).
Retrofittingword representations for unsupervised sense aware word similarities.
In *Proceedings of the LREC 2018* Miyazaki, Japan: European Language Resources Association.


Ustalov, D., Chernoskutov, M., Biemann, C., & Panchenko, A. (2017a).
Fighting with the sparsity of synonymy dictionaries for automatic synset induction.
In *International Conference on Analysis of Images, Social Networks and Texts* (pp. 94–105).: Springer.


Ustalov, D., Panchenko, A., & Biemann, C. (2017b).
Watset: Automatic induction of synsets from a graph of synonyms.

In *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)* (pp. 1579–1590). Vancouver, Canada: Association for Computational Linguistics.

Ustalov, D., Panchenko, A., Kutuzov, A., Biemann, C., & Ponzetto, S. P. (2018a).
Unsupervised semantic frame induction using triclustering.
arXiv preprint arXiv:1805.04715.

Ustalov, D., Teslenko, D., Panchenko, A., Chernoskutov, M., & Biemann, C. (2018b).
Word sense disambiguation based on automatically induced synsets.
In *LREC 2018, 11th International Conference on Language Resources and Evaluation : 7-12 May 2018, Miyazaki (Japan)* (pp. tba). Paris: European Language Resources Association, ELRA-ELDA.
Accepted for publication.