



Universität Hamburg  
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Alexander Panchenko

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

# In close collaboration with ...



**Chris Biemann**



**Dmitry 'Tsar' Ustalov**



**Stefano Faralli**



**Simone P. Ponzetto**

**GRAPHS**  
~~**PUNKS**~~  
**NOT DEAD**

## In collaboration with ...

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

# 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]

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### ■ **inducing semantic classes** [Panchenko et al., 2018b]

## ■ **Making induced senses interpretable**

[Panchenko et al., 2017b, Panchenko et al., 2017c]

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### ■ **inducing semantic classes** [Panchenko et al., 2018b]

## ■ **Making induced senses interpretable**

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## ■ **Linking induced word senses to lexical**

**resources** [Panchenko, 2016, Faralli et al., 2016, Panchenko et al., 2017a, Biemann et al., 2018]

## ■ A shared task on word sense induction

[Panchenko et al., 2018a, Arefyev et al., 2018]



- **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**.

- **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**.

Shared task on word sense induction

# A shared task on WSI

- An **ACL SIGSLAV** sponsored shared task on **word sense induction (WSI)** for the Russian language.
- **More details:** <http://russe.nlpub.org/2018/wsi>



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  - “Oh, the **bank** was robbed. They took about a million dollars.”
  - “**bank** of Elbe is a good and popular hangout spot complete with good food and fun”

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  - “**bank** of Elbe is a good and popular hangout spot complete with good food and fun”
- You need to **group the contexts by senses**:
  - “river **bank** is a slope beside a body of water”
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Extra slides



# 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, $\alpha = 0.05$ , 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



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*In Journal of Natural Language Engineering* (pp. 56–64).: Cambridge Press.



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Linked disambiguated distributional semantic networks.

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Panchenko, A. (2016).

Best of both worlds: Making word sense embeddings interpretable.

*In LREC.*



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