Universität Hamburg
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INDUCING INTERPRETABLE WORD SENSES FOR WSD AND ENRICHMENT OF LEXICAL RESOURCES

Overview

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

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

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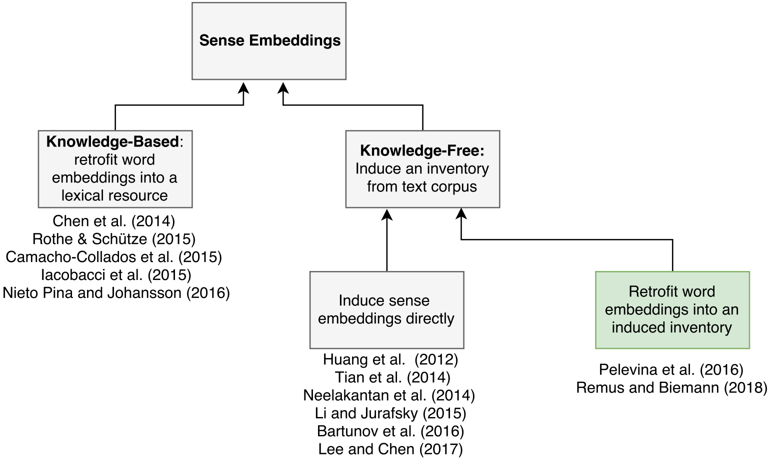
- **Making the induced senses interpretable** [Panchenko et al., 2017b, Panchenko et al., 2017c]
- **Linking induced word senses to lexical resources** [Faralli et al., 2016, Panchenko et al., 2017a, Biemann et al., 2018]

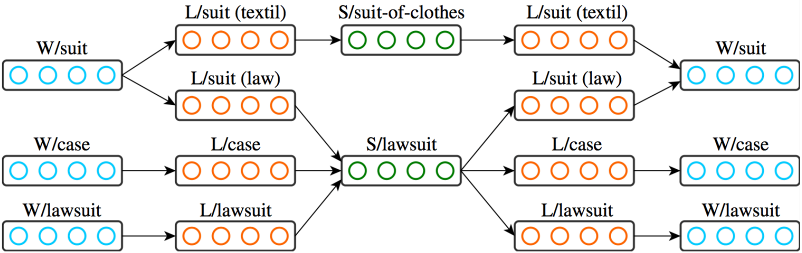
Inducing word sense representations

Related work



Related work: knowledge-based

- **AutoExtend** [Rothe and Schütze, 2015]



* image is reproduced from the original paper

Related work: knowledge-free

- **Adagram** [Bartunov et al., 2016]
- Multiple vector representations θ for each word:

$$p(Y, Z, \beta | X, \alpha, \theta) = \prod_{w=1}^{V} \prod_{k=1}^{\infty} p(\beta_{wk} | \alpha) \prod_{i=1}^{N} [p(z_i | x_i, \beta) \prod_{j=1}^{C} p(y_{ij} | z_i, x_i, \theta)],$$

  - α -- a meta-parameter controlling number of senses;
  - z_i -- a hidden variable: a sense index in context;
  - $p(\beta_{wk}|\alpha)$ -- probability of the k-th sense of the word w;
  - $p(z_i|x_i, \beta)$ -- probability of observing word x_i in the sense z_i;
  - $\prod_{j=1}^{C} p(y_{ij}|z_i, x_i, \theta)$ -- probability of the context C.

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  - $\prod_{j=1}^{C} p(y_{ij} | z_i, x_i, \theta)$ -- probability of the context C.
- **See also**: [Neelakantan et al., 2014] and [Li and Jurafsky, 2015]

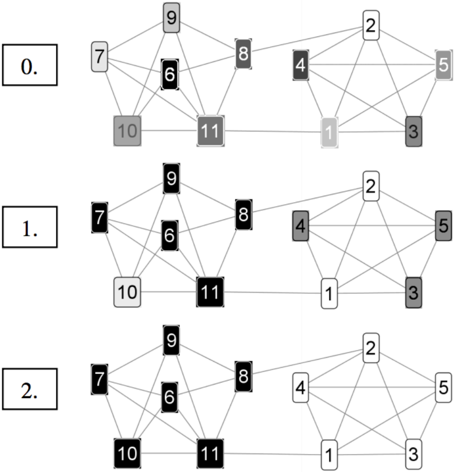
Related work: word sense induction

- Word sense induction (WSI) based on **graph clustering**:
  - [Lin, 1998]
  - [Pantel and Lin, 2002]
  - [Widdows and Dorow, 2002]
  - **[Biemann, 2006]**
  - [Hope and Keller, 2013]

Related work: Chinese Whispers#1

* source of the image: `http://ic.pics.livejournal.com/blagin_anton/33716210/2701748/2701748_800.jpg`

Related work: Chinese Whispers#2



Sense embeddings using retrofitting

RepL4NLP@ACL'16 [Pelevina et al., 2016], LREC'18 [Remus and Biemann, 2018]

Prior methods:

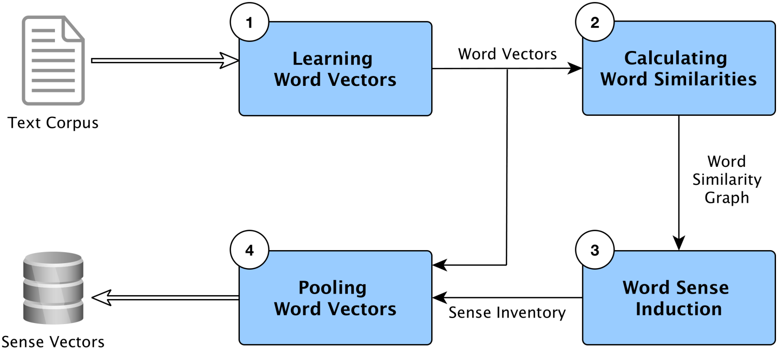
- Induce inventory by clustering of word instances
- Use existing sense inventories

Our method:

- **Input:** word embeddings
- **Output:** word sense embeddings
- **Word sense induction** by clustering of word ego-networks

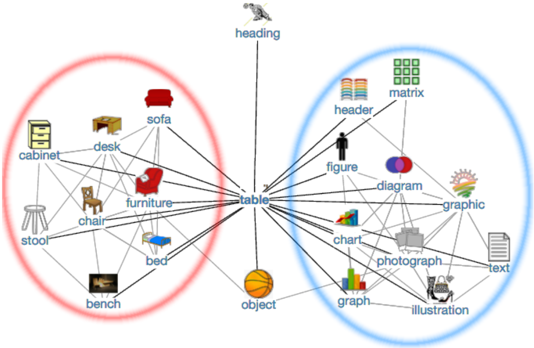
Sense embeddings using retrofitting

- From word embeddings to sense embeddings



Sense embeddings using retrofitting

- Word sense induction using ego-network clustering



Sense embeddings using retrofitting

- Word sense induction using ego-network clustering

Sense embeddings using retrofitting

Neighbours of Word and Sense Vectors

Vector	Nearest Neighbours
table	tray, bottom, diagram, bucket, brackets, stack, basket, list, parenthesis, cup, trays, pile, playfield, bracket, pot, drop-down, cue, plate
table#0	leftmost#0, column#1, randomly#0, tableau#1, top-left0, indent#1, bracket#3, pointer#0, footer#1, cursor#1, diagram#0, grid#0
table#1	pile#1, stool#1, tray#0, basket#0, bowl#1, bucket#0, box#0, cage#0, saucer#3, mirror#1, birdcage#0, hole#0, pan#1, lid#0

- Neighbours of the word ``table" and its senses produced by our method.

Sparse sense representations

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Watset: synset induction

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Induction of sense semantic classes

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Conclusion

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- How to **induce word senses**, **synsets** and **semantic classes** from text and synonyms.

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- How to **induce word senses**, **synsets** and **semantic classes** from text and synonyms.
- **Interpretability can be added** on the top of induced word senses in a model agnostic way.
- Hypernymy labels **improve hypernymy extraction**.
- Linking induced word senses to lexical resources:
  - improves **performance of WSD**;
  - can be used to **enrich lexical resources** with new senses.

A New Shared Task on WSI&D

- Participate in an ACL SIGSLAV sponsored shared task on **word sense induction and disambiguation** for Russian!

A lexical sample task evaluated using the ARI measure

- Target word, e.g. ``bank'' (in Russian).
- Contexts where the word occurs.
- You need to group the contexts by senses.

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- **More details**: `http://russe.nlpub.org/2018/wsi`
- You can participate by **31.01.2018**.

Thank you!

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