

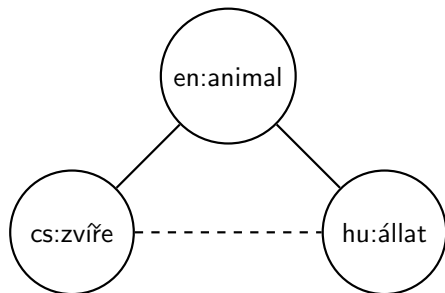
# Filtering Wiktionary triangles by linear mapping between distributed word models

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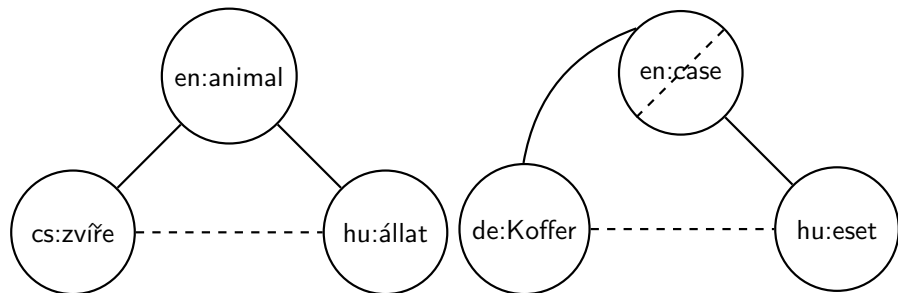
LREC 2016

# Triangulation



- pruning triangles
  - number of pivots (Tanaka and Umemura, 1994)
  - based on distributional similarity
    - comparable corpora (Saralegi et al., 2011)
    - now: with monolingual corpora

# Triangulation

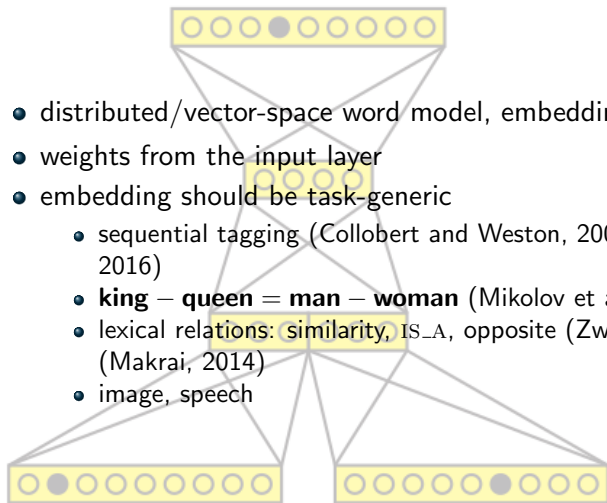


- pruning triangles

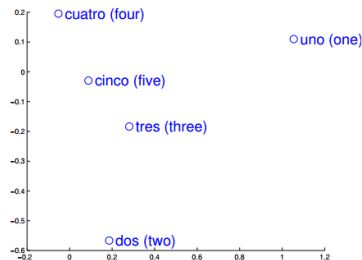
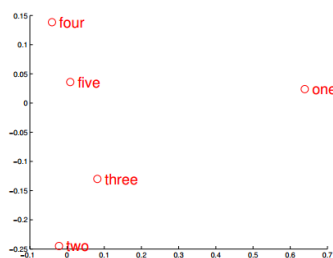
- number of pivots (Tanaka and Umemura, 1994)
- based on distributional similarity
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  - now: with monolingual corpora

# Embeddings

- distributed/vector-space word model, embedding
- weights from the input layer
- embedding should be task-generic
  - sequential tagging (Collobert and Weston, 2008; Pajkossy and Zséder, 2016)
  - **king** – **queen** = **man** – **woman** (Mikolov et al., 2013d; Makrai, 2015)
  - lexical relations: similarity, IS\_A, opposite (Zweig, 2014), cause (Makrai, 2014)
  - image, speech



# Linear translation (Mikolov et al., 2013b)



$$W : \mathbb{R}^{d_1} \rightarrow \mathbb{R}^{d_2} \quad z \approx Wx$$

- learning the mapping:  
supervised by a seed dictionary

$$\min_W \sum_i \|Wx_i - z_i\|^2$$

- generate or score translations
- hub: some targets are erroneous translations of many sources (Dinu et al., 2015)

- 5 K train + 1 K test

- seed dictionary extracted from Wiktionary with <https://github.com/juditacs/wikt2dict> handles 43 editions
- embeddings
  - German
    - SdeWaC (Baroni et al., 2009)
  - Hungarian
    - Webkorpusz (Halácsy et al., 2004)  $\oplus$  Hungarian National Corpus (Oravecz et al., 2014)

- seed dictionary extracted from Wiktionary with <https://github.com/juditacs/wikt2dict> handles 43 editions
- embeddings
  - German
    - SdeWaC (Baroni et al., 2009)
    - continuous bag of words (cbow) , 300 dim, cut-off 100
  - Hungarian
    - Webkorporusz (Halácsy et al., 2004)  $\oplus$  Hungarian National Corpus (Oravecz et al., 2014)
    - cbow, 600 dim, cut-off 10
    - embeddings trained with word2vec (Mikolov et al., 2013a,c)
- translation matrix
  - tool: we forked Dinu et al. (2015) to <https://github.com/makrai/dinu15/>
  - trained on the 5 K direct word pairs that are supported by the most pivots in Wiktionary

- two rankings
- gold dictionary from the OPUS project extracted by (Tiedemann, 2012) from the OpenSubtitles2013 parallel corpus,
  - a collection of translated movie subtitles  
<http://www.opensubtitles.org/> in 59 languages

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|                      |        |
|----------------------|--------|
| documents            | 3208   |
| sentences            | 3.2 M  |
| German tokens        | 23.3 M |
| Hungarian tokens     | 19.7 M |
| extracted word pairs | 29.1 K |

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Table : The German Hungarian section of the OpenSubtitles2013



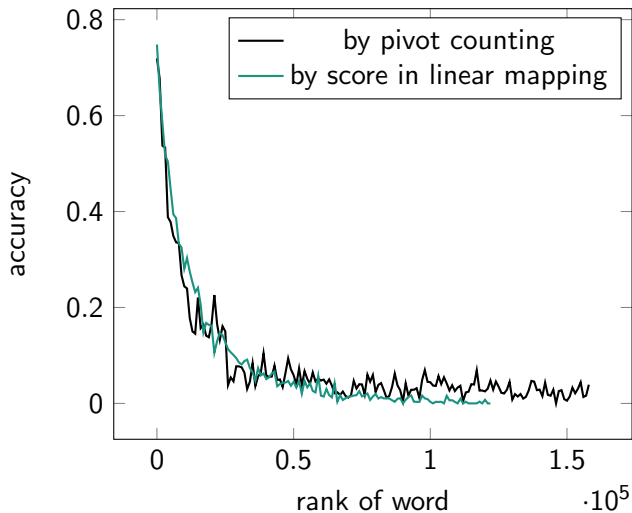
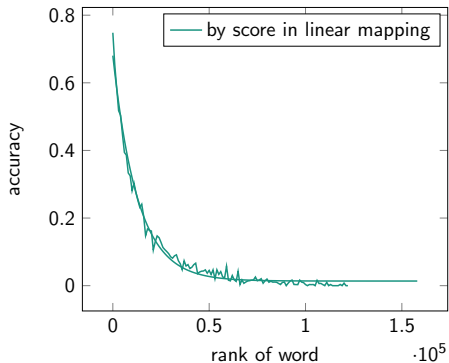
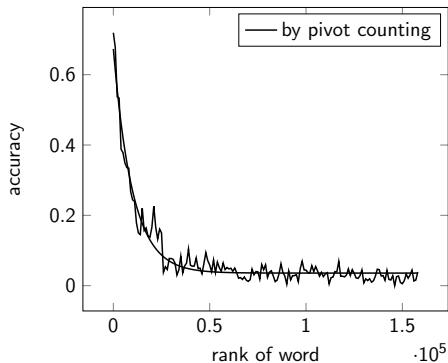


Figure : Accuracy curves in two ranking

# Smoothness

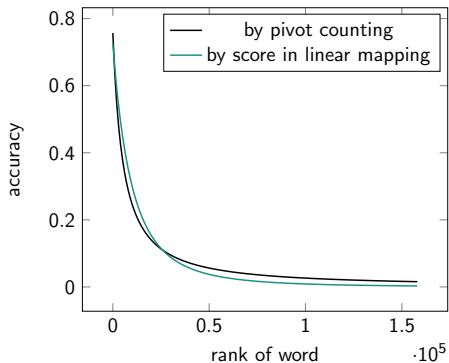
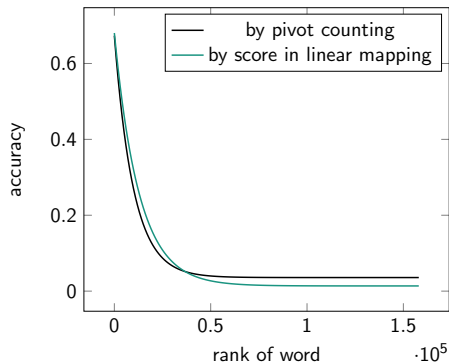


- mean squared error from
- exponential,  $a \cdot \exp(-bx) + c$
- power law,  $a \cdot (bx + c)^k$

| scoring method | exp               | power law         |
|----------------|-------------------|-------------------|
| pivot counting | 6.1859e-04        | 5.2182e-04        |
| linear mapping | <b>2.4574e-04</b> | <b>1.1789e-04</b> |
| ratio          | 2.51              | 4.42              |

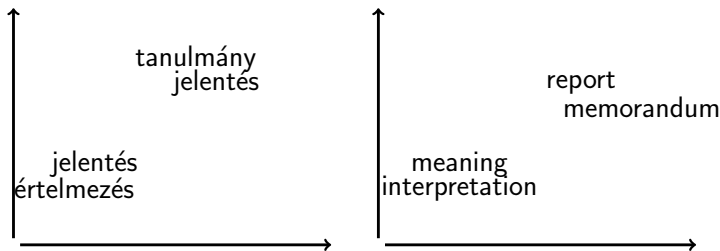
Table : Mean squared error

# Top 20–30 000 pairs



# Perspectives

- multi-sense embedding (Reisinger and Mooney, 2010; Huang et al., 2012)
- non-uniform number of senses (Neelakantan et al., 2014; Bartunov et al., 2015)
- in some NLP tasks (Li and Jurafsky, 2015)
- granularity (Borbély, Makrai, Nemeskey, and Kornai, submitted to repevalacl16)
  - number of senses correlated traditional lexicons
  - different sense  $\Leftrightarrow$  different translation



- <http://corpus.nytud.hu/efnilex-vect/>
- [makrai@nytud.hu](mailto:makrai@nytud.hu)
- Work supported by the EFNILEX project of the European Federation of National Institutions for Language.

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| German                    | OpenSubtitles2013              | triangulated                      |
|---------------------------|--------------------------------|-----------------------------------|
| Ernährung 'nutrition'     | táplálkozás 'nutrition'        | diéta 'diet'                      |
| ekelhaft 'disgusting'     | gusztustalan 'disgusting'      | koszos 'dirty'                    |
| Aufnahme                  | felvételt, felvétel            | átvétel                           |
| Folge (noun)              | kövesd (verb)                  | <b>eredmény</b> (noun)            |
| Terror                    | terror                         | rettegés 'dread'                  |
| strikt                    | szigorú <b>ak</b>              | <b>merev</b>                      |
| dunkel (adj)              | sötét (adj)                    | sötétedés (noun)                  |
| dünn                      | vékony, sovány                 | flamingó 'flamenco'               |
| Demonstration             | bemutató                       | bemutatás (action noun)           |
| Ablenkung 'relief'        | <b>elterelés</b> 'distraction' | <b>szünet</b> 'pause'             |
| Rüssel                    | ormány 'trunk'                 | szaglás 'smelling (sense)'        |
| Geruchssinn 'smelling'    | szaglás <b>od</b>              | kürt 'horn'                       |
| Koffer                    | bőröndöt, bőrönd               | <b>eset</b> 'de:Fall'             |
| Verbindung 'connecion'    | kapcsolat 'connecion'          | kapcsolattartó 'contact (person)' |
| Uhr 'clock'               | kor, óra 'clock'               | karóra 'watch'                    |
| absorbieren 'absorbieren' | nyelni 'absorb'                | furcsa 'strange'                  |
| Schwule 'gay'             | melege <b>ek</b> 'gays'        | sor 'line, row, queue'            |
| Hubschrauber 'helicopter' | helikoptert, helikopter        | húsbárd 'chopper (for meat)'      |

- web corpora (SdeWaC, the Hungarian Webcorpus)
- “curated” corpus (the Hungarian National Corpus, 754 million words)
- Wiktionary: crowd-sourced but otherwise causal dictionary
- reference dictionary extracted from movie subtitles
- domain mismatch is negligible