A key to **unsupervised semantic change modeling** is to **reduce cluster granularity**

Similarity-Based Cluster Merging for Semantic Change Modeling

Christopher Brückner *bruckner@ufal.mff.cuni.cz*
Leixin Zhang *l.zhang-5@utwente.nl*
Pavel Pecina *pecina@ufal.mff.cuni.cz*

CHARLES UNIVERSITY
ÚFAL

AXOLOTL'24 baseline

- Embed old senses and modern usage examples
- Cluster modern usage embeddings
- **Greedily assign old senses to clusters**

Our approach

- Embed old senses and modern usage examples
- Cluster modern usage embeddings
- **Non-greedily assign old senses to clusters: Merge clusters if multiple good candidates exist**
- **Repeat the previous step for remaining clusters: Use cluster centroids as novel sense embeddings**

Method

Pass 1: Word Sense Disambiguation

- Given old sense inventory S and threshold τ, for each cluster C with centroid $\overline{\mathbf{c}}$, assign a cluster sense

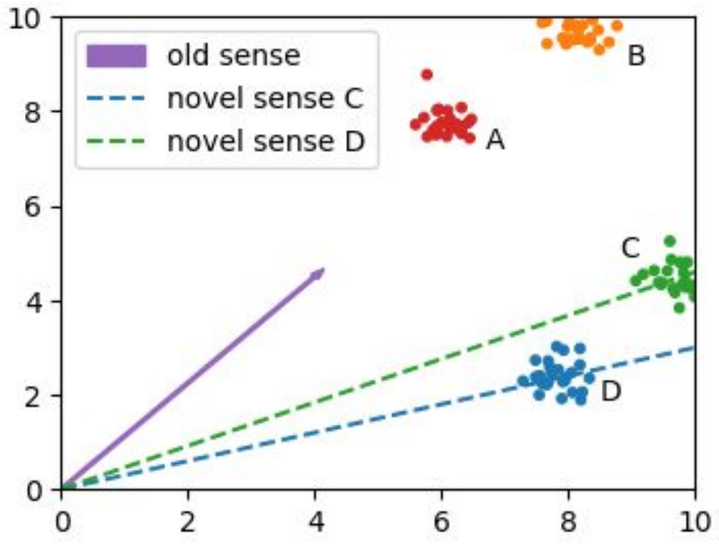
$$s_C = \begin{cases} argmax_{s \in S} \cos(\mathbf{s}, \overline{\mathbf{c}}), & \cos(\cdot) \geq \tau \\ s_{novel}, & otherwise \end{cases}$$

Pass 2: Word Sense Induction

- Induce and merge induced novel senses by updating the index of each remaining cluster C_i

$$i \leftarrow \begin{cases} argmax_{j > i} \cos(\overline{\mathbf{c}}_i, \overline{\mathbf{c}}_j), & \cos(\cdot) \geq \tau \\ i, & otherwise \end{cases}$$

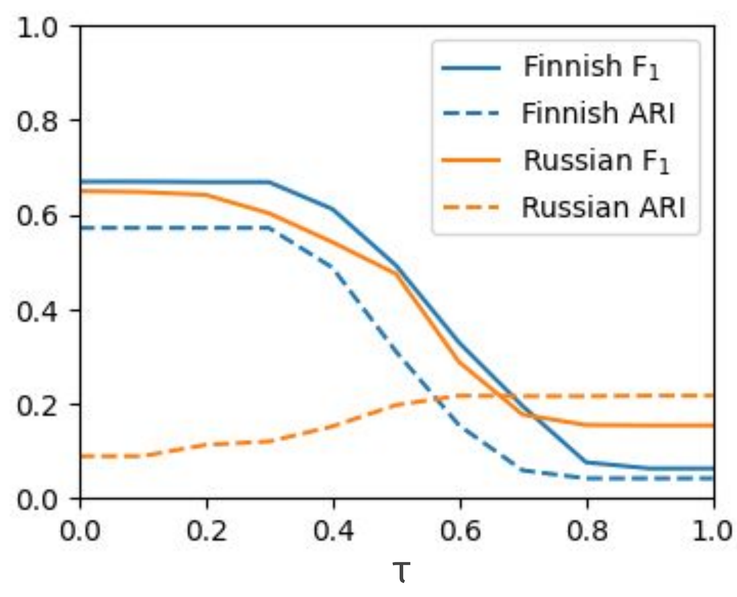
Example



Pass 1: Merge clusters A and B, assign the same old sense ID
Pass 2: Merge clusters C and D, assign the same novel sense ID

Experiments

Behavior for different τ



Results (avg. Fi-Ru-De)

Team	ARI	F1
deep-change	0.413	0.750
Holotniekat (ours)	0.335	0.641
TartuNLP	0.310	0.590
IMS_Stuttgart	0.287	0.431
ABDN-NLP	0.221	0.487
WooperNLP	0.187	0.316
Baseline	0.041	0.207

Future work

- Use different thresholds to merge old and novel sense clusters
- Fuse the two passes instead of handling them as separate tasks

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https://github.com/chbridges/axolotl24