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The LSCD Benchmark:
a Testbed for Diachronic Word Meaning Tasks

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Introduction

- **Lexical Semantic Change Detection** (LSCD) (Schlechtweg, 2023)
  - goal: automate the analysis of changes in word meanings over time
    (1) *Der zweyte Theil vom Bauernrechte ist schon lange aus der **Presse**;*
    'The second part of Farmers' Rights already left the **press**;'
    (2) *Alle Freiheiten suspendirt! die persönliche Freiheit wie die der **Presse**!*
    'All freedoms suspended! the personal freedom as well as the one of the **press**!'
- complex, lemma-level task
- operationalized by **Word-in-Context** (WiC) annotations and subsequent **Word Sense Induction** (WSI) on weighted graph
- **modularity** and **heterogeneity** in models, datasets and tasks

→ create one repository[1] standardizing model component combinations, dataset preprocessing and evaluation

[1] `https://github.com/Garrafao/LSCDBenchmark`

Related Work

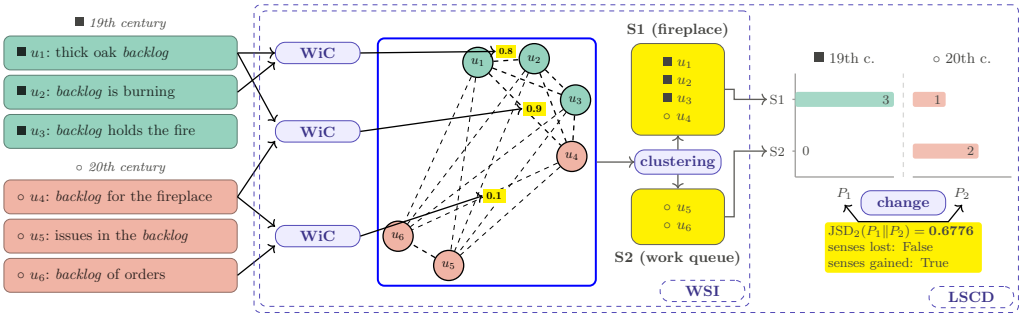
- shared tasks (Ahmad et al., 2020; Basile et al., 2020; Fedorova et al., 2024; Kutuzov & Pivovarova, 2021; Schlechtweg et al., 2020; Zamora-Reina et al., 2022)
- comprehensive studies with code repositories (Periti & Tahmasebi, 2024; Schlechtweg et al., 2019)

→ no comprehensive benchmark with flexible model & evaluation implementation

Tasks

1. Word-in-Context
2. Word Sense Induction
3. Lexical Semantic Change Detection

Tasks


19th century
u_1: thick oak backlog
u_2: backlog is burning
u_3: backlog holds the fire
20th century
u_4: backlog for the fireplace
u_5: issues in the backlog
u_6: backlog of orders
WiC
WiC
WiC
0.8
0.9
0.1
S1 (fireplace)
S2 (work queue)
clustering
WSI
19th c.
20th c.
S1
S2
3
1
0
2
P_1
change
P_2
$\mathrm{JSD}_2(P_1 \| P_2) = \mathbf{0.6776}$
senses lost: False
senses gained: True
LSCD

Datasets[2]

Dataset	LGS	n	N/V/A	|U|	AN	JUD	Task	t_1	t_2	Reference	Version
DWUG	DE	50	32/14/2	178	8	63k	WiC, WSI, LSCD (B,G,C)	1800–1899	1946–1990	Schlechtweg et al. (2021)	3.0.0
...											
DWUG	EN	46	40/6/0	191	13	29k	WiC, WSI, LSCD (B,G,C)	1810–1860	1960–2010	Schlechtweg et al. (2021)	3.0.0
...											
DWUG	SV	44	32/5/7	171	13	20k	WiC, WSI, LSCD (B,G,C)	1790–1830	1895–1903	Schlechtweg et al. (2021)	3.0.0
...											
DWUG	ES	100	51/24/25	40	12	62k	WiC, WSI, LSCD (B,G,C)	1810–1906	1994–2020	Zamora-Reina et al. (2022)	4.0.2
NorDiaChange1	NO	40	40/0/0	21	3	14k	WiC, WSI, LSCD (B,G,C)	1929–1965	1970–2013	Kutuzov et al. (2022)	1.0.0
...											
ChiWUG	ZH	40	10/22/8	40	4	61k	WiC, WSI, LSCD (B,G,C)	1954-1978	1979-2003	Chen et al. (2023)	1.0.0
DWUG	IT	26	17/3/6	86	5	5k	WiC, WSI, LSCD (B,G,C)	1948-1970	1990-2014	Cassotti et al. (2024)	3.0.0
DURel	DE	22	15/1/6	104	5	6k	WiC, LSCD (C)	1750–1800	1850–1900	Schlechtweg et al. (2018)	3.0.0
SURel	DE	22	19/3/0	104	4	5k	WiC, LSCD (C)	general	domain	Hätty et al. (2019)	3.0.0
RuSemShift1	RU	71	65/6/0	119	5	21k	WiC, LSCD (C)	1682–1916	1918–1990	Rodina and Kutuzov (2020)	2.0.0
...											

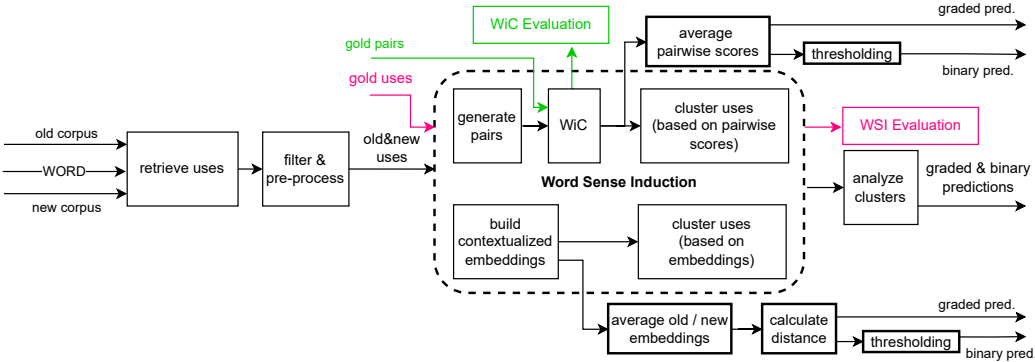
[2] https://www.ims.uni-stuttgart.de/data/wugs

Evaluation Procedures

- **WiC ranking** with Spearman's *rho*
- **WSI clustering** with Adjusted Rand Index
- **binary change classification** with F1
- **graded change ranking** with Spearman's *rho*
  - **COMPARE ranking** with Spearman's *rho*

- standard target word splits
  - CoMeDi split (Schlechtweg et al., 2025)

Models


old corpus
WORD
new corpus
retrieve uses
filter & pre-process
old&new uses
gold pairs
gold uses
WiC Evaluation
generate pairs
WiC
average pairwise scores
thresholding
graded pred.
binary pred.
cluster uses (based on pairwise scores)
WSI Evaluation
Word Sense Induction
analyze clusters
graded & binary predictions
build contextualized embeddings
cluster uses (based on embeddings)
average old / new embeddings
calculate distance
thresholding
graded pred.
binary pred.

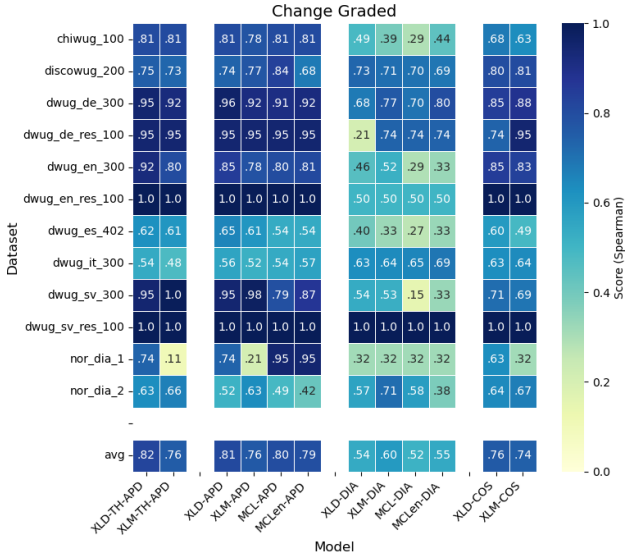
Usage Example

```
python main.py \
  dataset=dwug_de_210 \
  dataset/split=comedi_test \
  dataset/preprocessing=raw \
  task/wic@task.model.wic=contextual_embedder \
  task.model.wic.ckpt=bert-base-german-cased \
  task/wic/metric@task.model.wic.similarity_metric=cosine \
  task/lscd_graded@task.model=apd_compare_all \
  task=lscd_graded \
  evaluation=change_graded
```

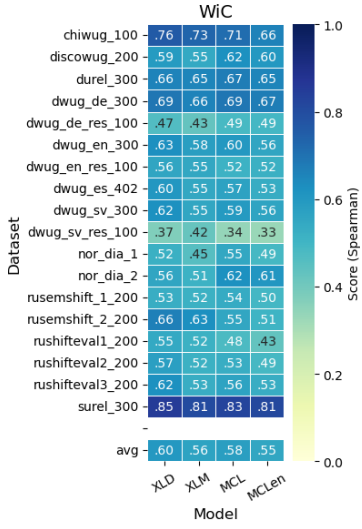
Experiments

- graded change ranking
- CoMeDi split
- WiC component
  - XL-LEXEME + cosine (Cassotti et al., 2023)
  - DeepMistake (MCL, MCLen) (Homskiy & Arefyev, 2022)
  - XL-DURel + cosine (Yadav & Schlechtweg, 2025)
- aggregation models
  - APD (Kutuzov & Giulianelli, 2020)
  - TH-APD (Schlechtweg et al., 2025)
  - DIA (Beck, 2020)
  - COS (Kutuzov & Giulianelli, 2020)

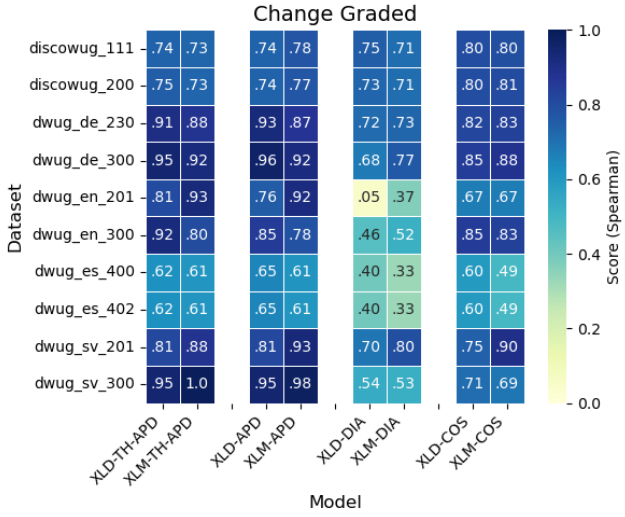
Which WiC model and which aggregate measure gives SOTA performance? Does WiC prediction discretization improve results?



Which model gives SOTA on diachronic WiC? Does WiC determine LSCD?



Are model performances reproducible with more reliable data? What is the performance development on incrementally annotated datasets?



Conclusion

- modular, flexible **benchmark repository**[3]
- integrates variety of models, datasets and evaluation procedures
- **findings**:
  - ordinal WiC models compete with their binary counterparts
  - discretization of graded WiC predictions helps
  - WiC performance roughly determines LSCD performance
  - performance on older dataset versions may be misleading

→ more closely **modelling the human annotation process** leads to better performance

[3] `https://github.com/Garrafao/LSCDBenchmark`

Limitations

- no clustering models
- non-optimal model training checkpoints
- data split size

Future Work

- clustering models (Schlechtweg et al., 2024)
- other training checkpoints (Homskiy & Arefyev, 2022)
- full or concatenated datasets
- recently developed aggregation measures (Goworek & Dubossarsky, 2026; Pranjić et al., 2025)

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