

Data Mining and Information Extraction Methods for Large-Scale High Quality Representations of Scientific Publications

Dissertation Defense

Tarek Saier | 22. April 2024



Data Mining and Information Extraction Methods
for Large-Scale High Quality
Representations of Scientific Publications

**Data Mining and Information Extraction Methods
for Large-Scale High Quality
Scholarly Data**

Scholarly Data

■ Usage

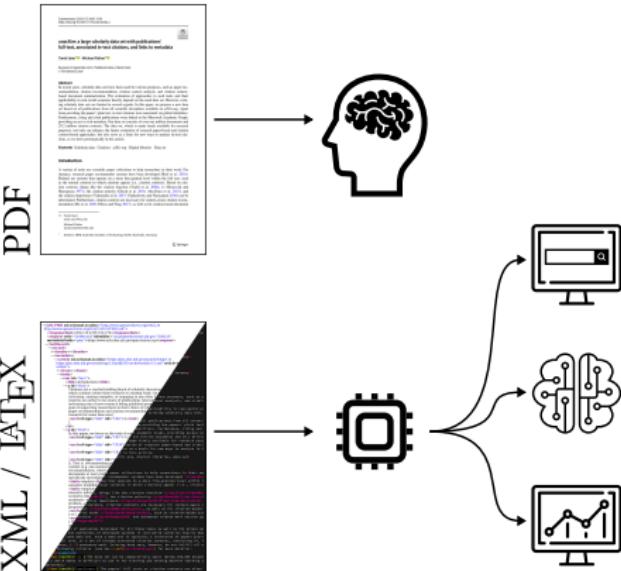
- Services (Search, Recommendation, Stats)
 - ML models (LLMs, summarization, recommender systems)
 - Analyses (temporal, geographic, institutional)

■ Flavors

- Metadata (MAG, OpenAlex, ORKG, crossref)
 - Documents (Core, arXMLiv, PMC)
 - Linked Documents (unarXive, S2ORC)

■ Data Sources

- PDF (Core, ACL Anthology)
 - XML (PubMed, PLOS, publisher internal)
 - LaTeX (arXiv)



Motivation

Background

Outline

Corpus
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Corpus



Cit. Netw. & Non-Eng. Docs
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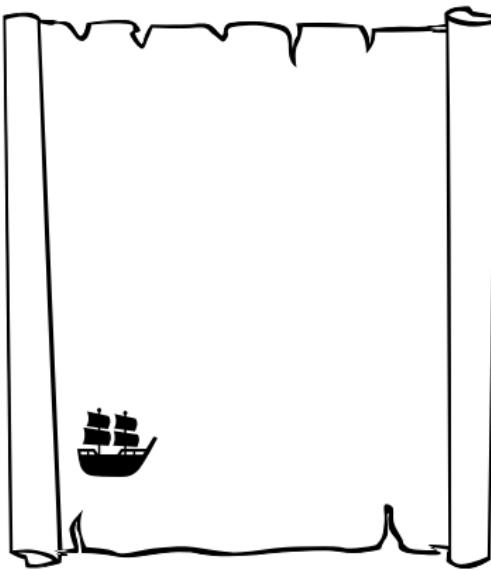
Artifact Parameters

Conclusion

References

Analogy

Maps of the Sea



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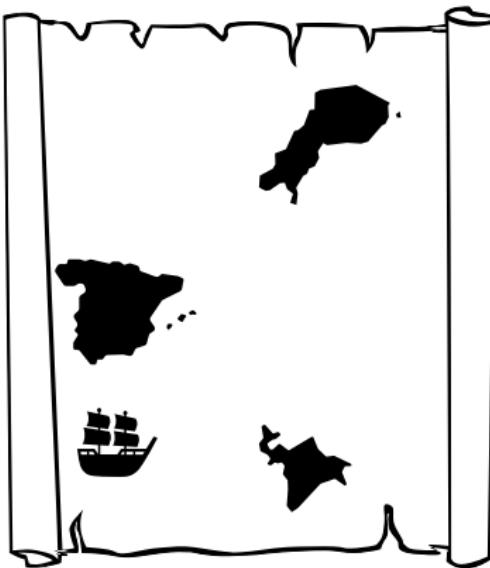
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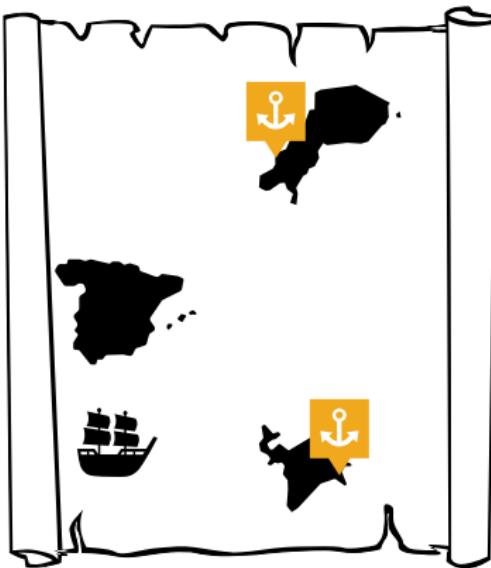
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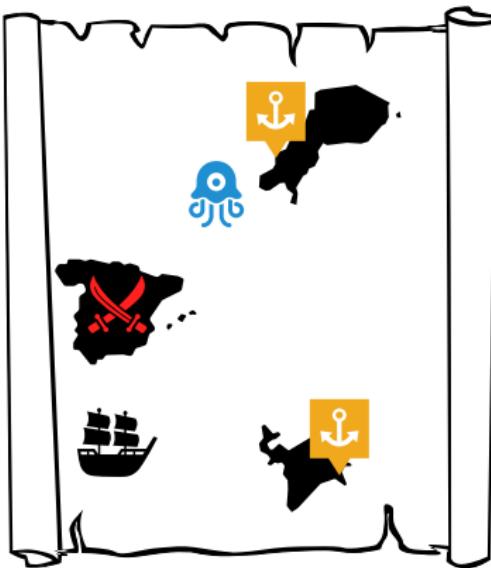
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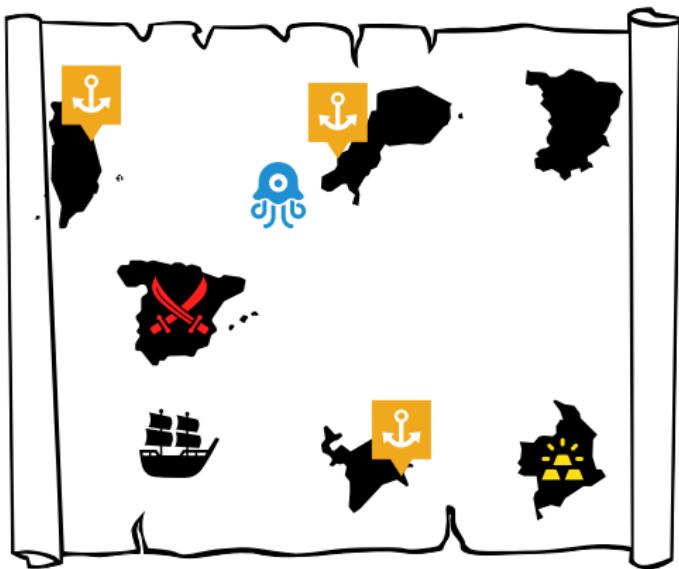
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Maps of the Sea / Maps of Science

The Sailor looks for

- Port to trade
- Island to explore

The Scientist looks for

- Paper to read
- Venue to publish at
- Research idea to explore

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Maps of the Sea / Maps of Science

The Trade Company looks for

- Routes to expand
- Ports to build
- Sailor to hire

The University/Funding Body looks for

- Research to fund
- Researcher to hire
- Policy to establish

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- Policy to establish

better maps¹ ⇒ better decisions

¹Abstract representations of the real world

Maps of the Sea / Maps of Science

The Trade Company looks for

- Routes to expand
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The University/Funding Body looks for

- Research to fund
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- Policy to establish

false maps ⇒ misleading/false analyses, models, etc.

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The Trade Company looks for

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- Researcher to hire
- Policy to establish

our maps of science are insufficient¹

¹Used data sets are small, incomplete, noisy, etc.

Maps of the Sea / Maps of Science

The Trade Company looks for

- Routes to expand
- Ports to build
- Sailor to hire

The University/Funding Body looks for

- Research to fund
- Researcher to hire
- Policy to establish



Research Objective

Develop methods for generating high-quality scholarly data.

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Representations of Scientific Publications

Maps of Science



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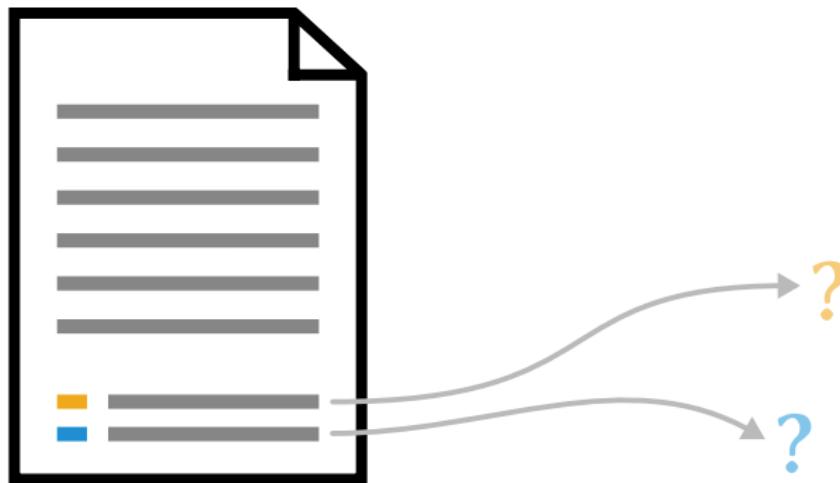
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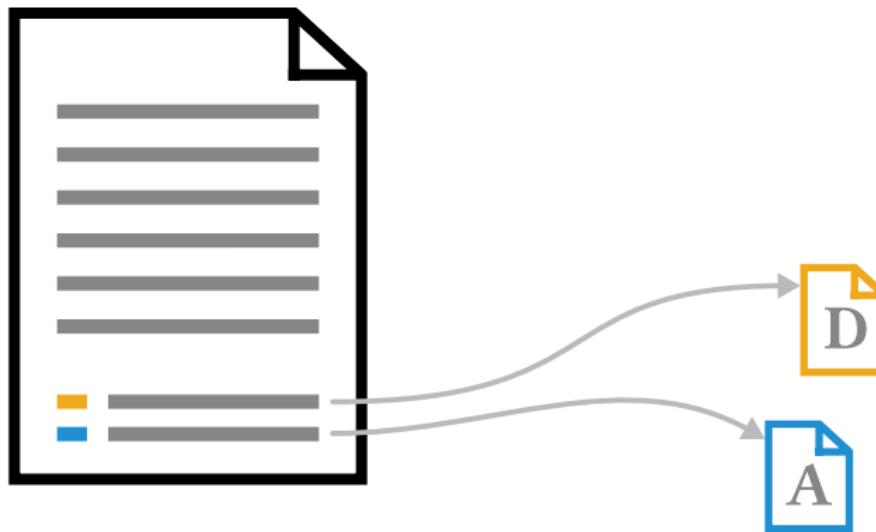
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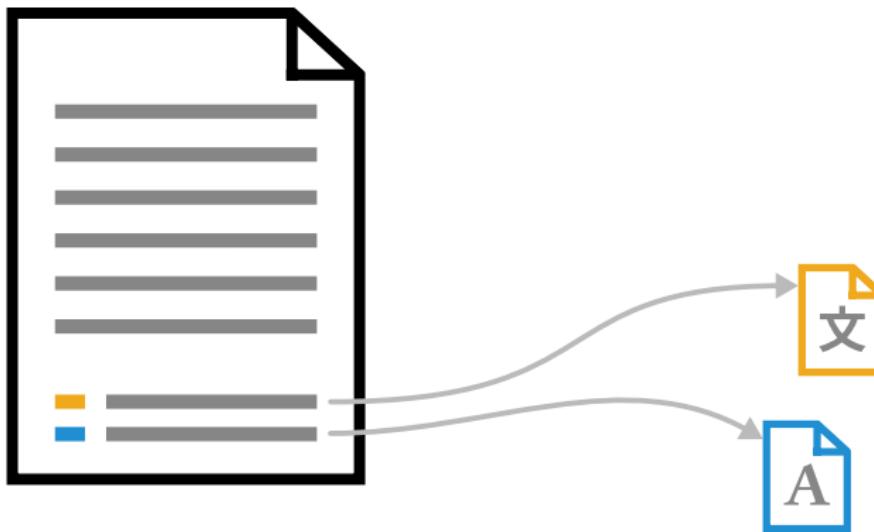
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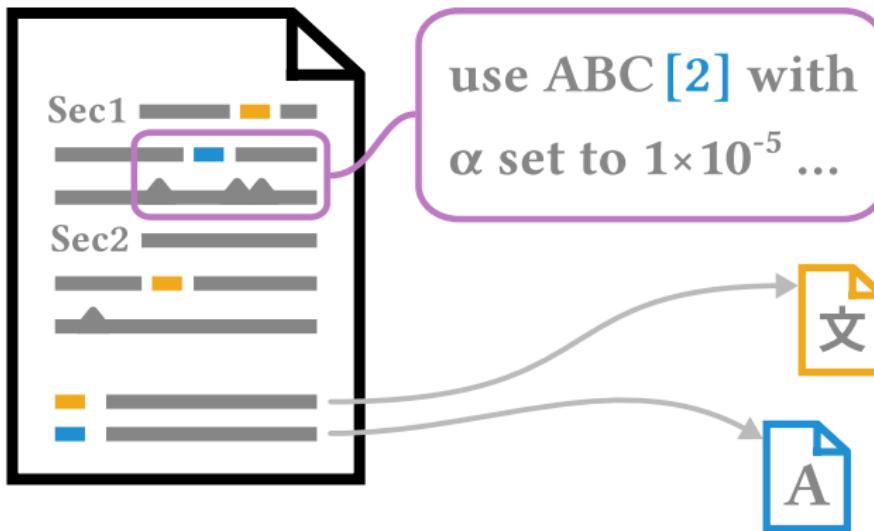
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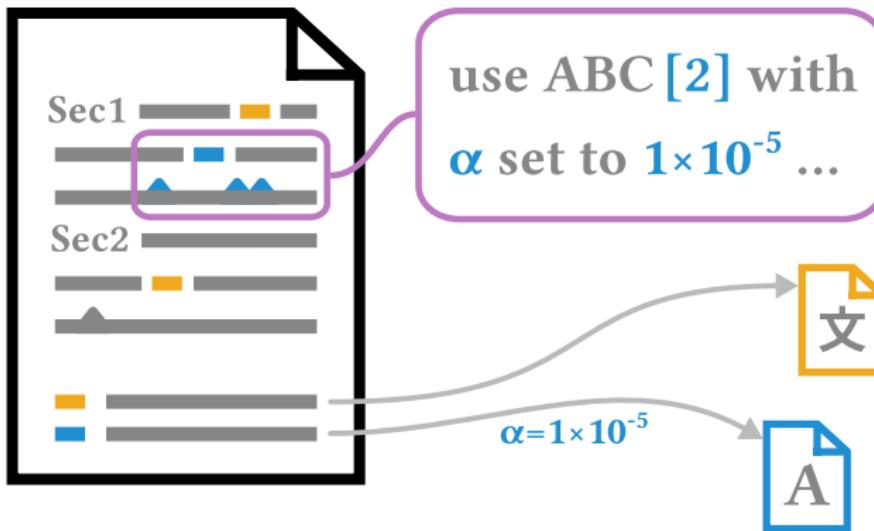
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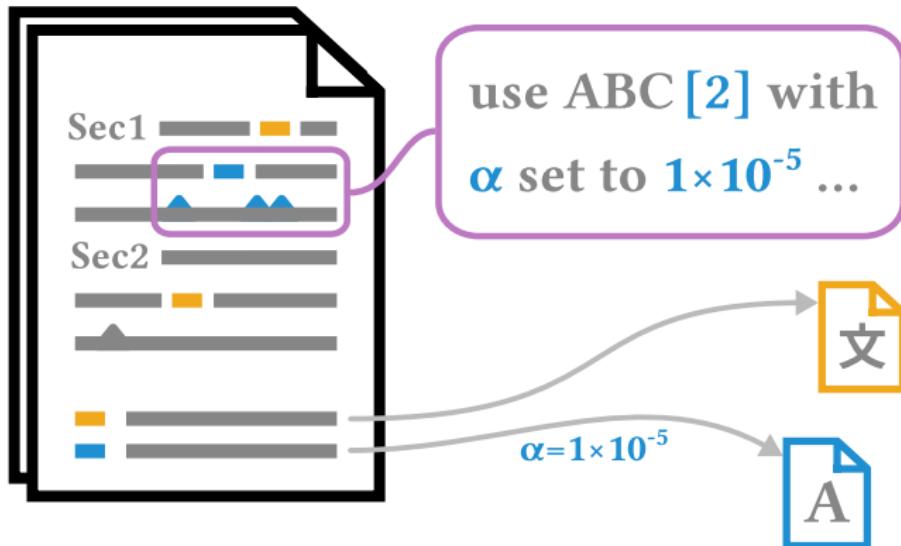
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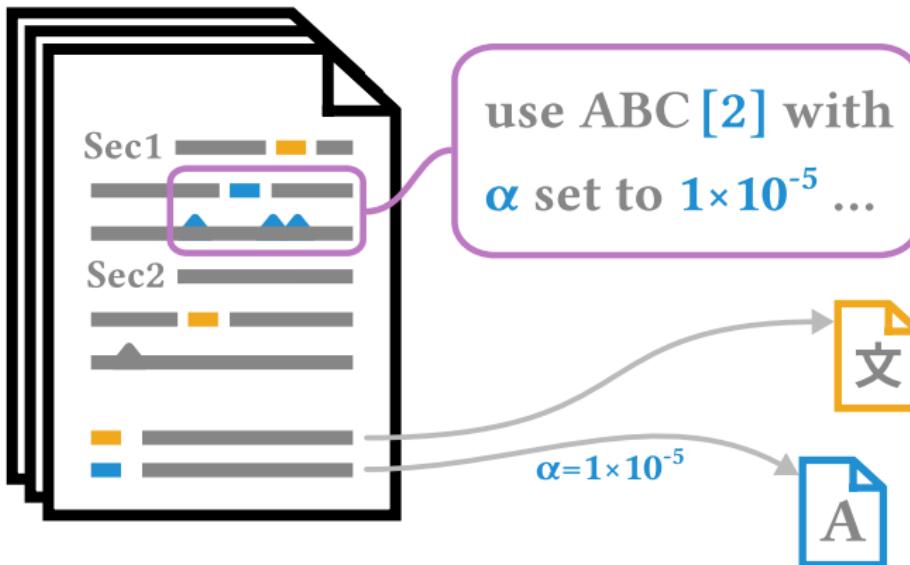
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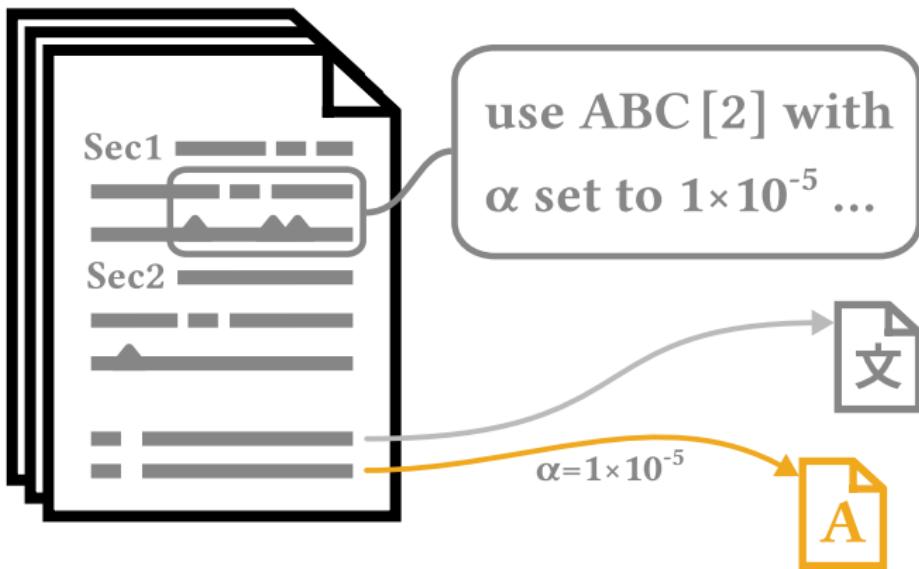
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Research Gap: Citation Network



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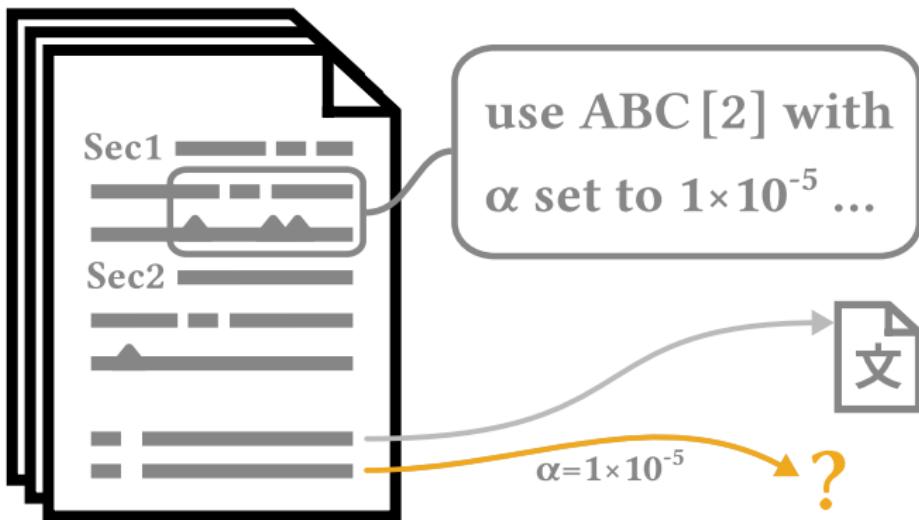
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Research Gap: Citation Network



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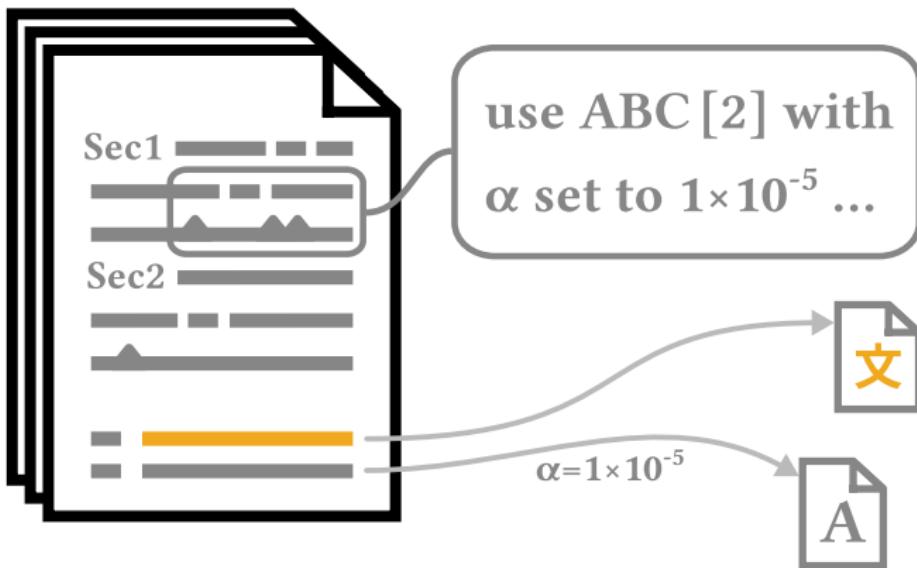
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Research Gap: Non-English Documents



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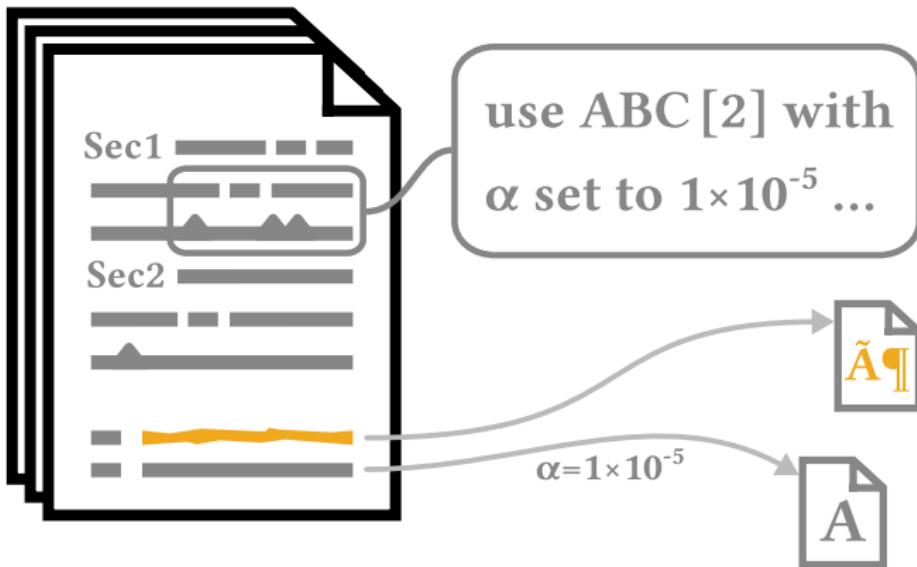
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Research Gap: Non-English Documents



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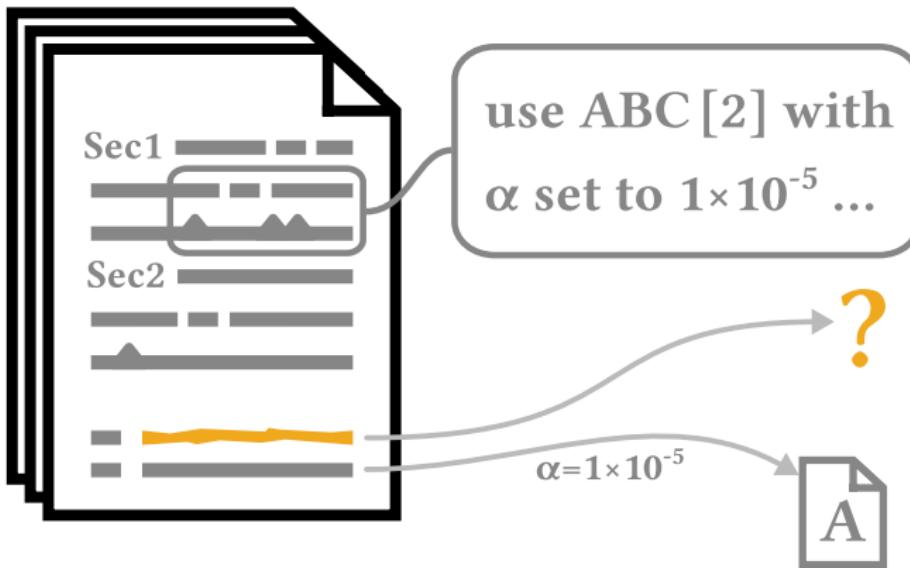
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Research Gap: Non-English Documents



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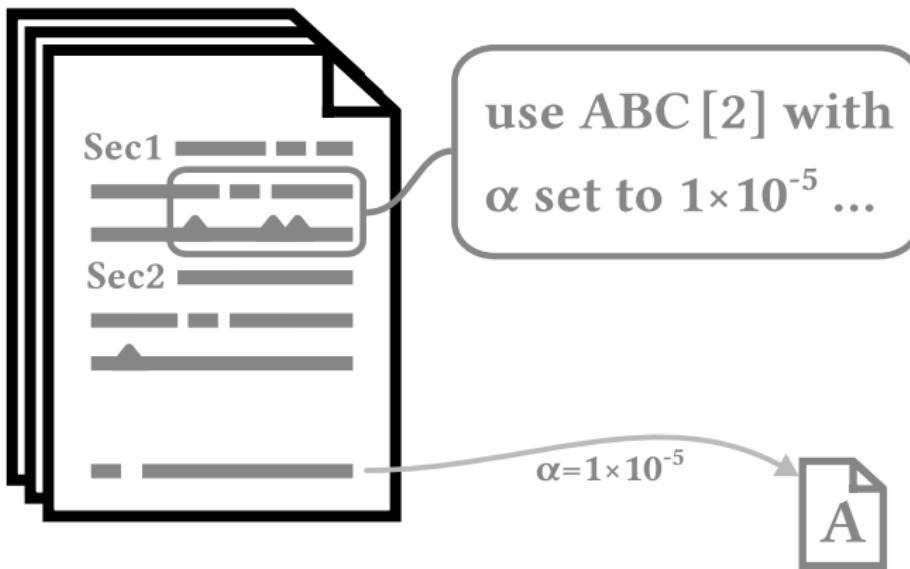
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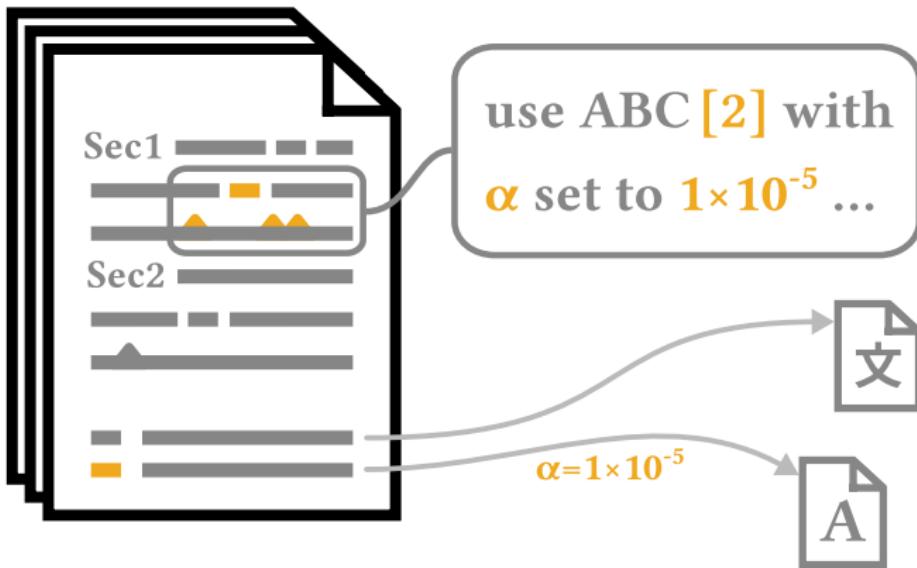
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Research Gap: Artifact Parameters



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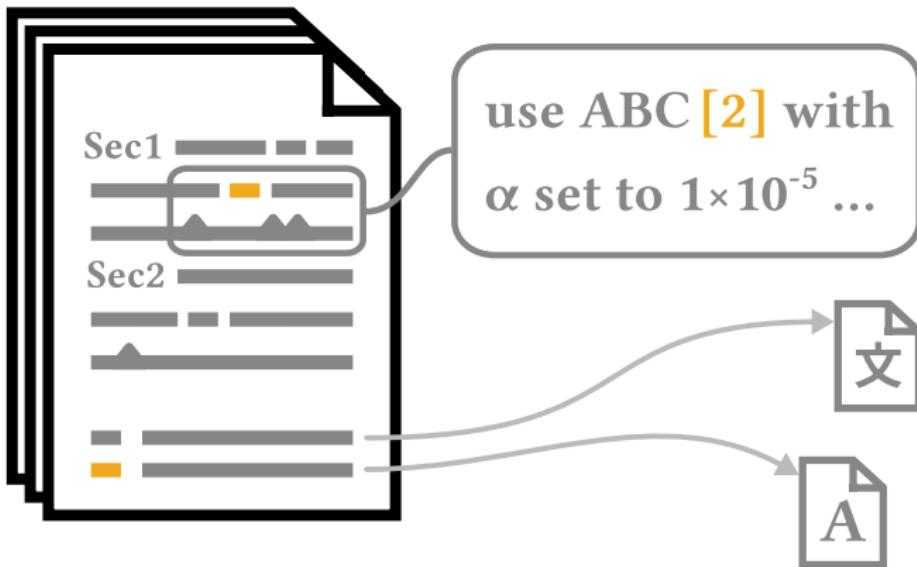
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Data Mining and Information Extraction Methods

for Large-Scale High Quality Representations of Scientific Publications



Research Objective



Research Objective

Research Gap

RT2: Citations

RT3: Non-English

RT4: Artifacts



Research Objective

Base

RT1: Corpus

Research Gap

RT2: Citations

RT3: Non-English

RT4: Artifacts



Research Objective



Data Quality

Base

RT1: Corpus

Research Gap

RT2: Citations

RT3: Non-English

RT4: Artifacts



Research Objective



Base

Research Gap

RT1: Corpus

RT2: Citations

RT3: Non-English

RT4: Artifacts

Data Quality





Research Objective



Data Quality

Base

Research Gap

RT1: Corpus

RT2: Citations

RT3: Non-English

RT4: Artifacts



✓ | X



✓ | X



✓ | X



✓ | X



✓ | X

✓ | X

✓ | X

✓ | X

✓ | X

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✓ | X



Research Objective



Data Quality



Base

RT1: Corpus

- ① conversion and linking pipeline
- ② extensive corpus analysis

[Scientometrics'20]

RT2: Citations

- ① improved corpus pipeline
- ② blocking method for reference linking

[ULITE'22]
[JCDL'23]

Research Gap

RT3: Non-English

- ① extraction method for cross-lingual cit.
- ② extensive citation analysis

[ICADL'20]
[IJDL'22]

RT4: Artifacts

- ① novel IE task and data set
- ② IE model development and eval.

[ECIR'24]



Research Objective



Data Quality



Base

RT1: Corpus

- ① conversion and linking pipeline
- ② extensive corpus analysis

[Scientometrics'20]

Research Gap

RT2: Citations

- ① improved corpus pipeline
- ② blocking method for reference linking

[ULITE'22]
[JCDL'23]

RT3: Non-English

- ① extraction method for cross-lingual cit.
- ② extensive citation analysis

[ICADL'20]
[IJDL'22]

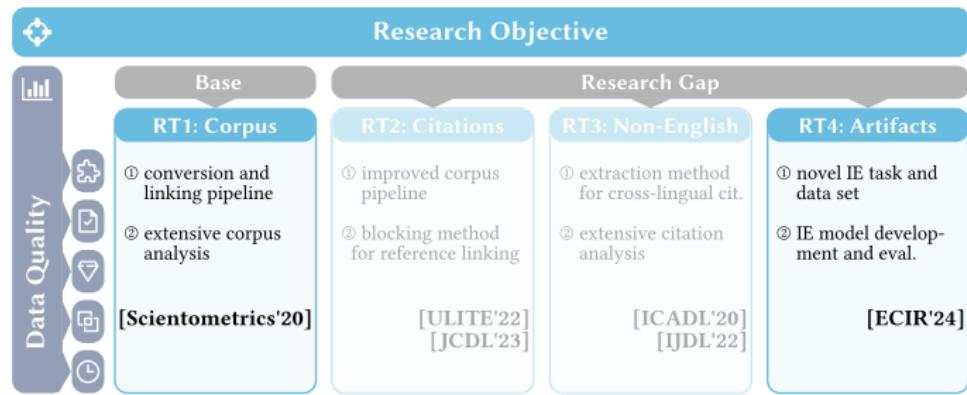
RT4: Artifacts

- ① novel IE task and data set
- ② IE model development and eval.

[ECIR'24]

Outline

- **Corpus**
 - Challenges
 - Solutions
 - Resulting Corpus
- **Citation Network**
- **Non-English Documents**
- **Artifact Parameters**
 - Task Definition
 - Methods
 - Results
- **Conclusion**
 - Contributions
 - Impact



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Corpus

unarXive

Corpus - Digest

■ Research Task

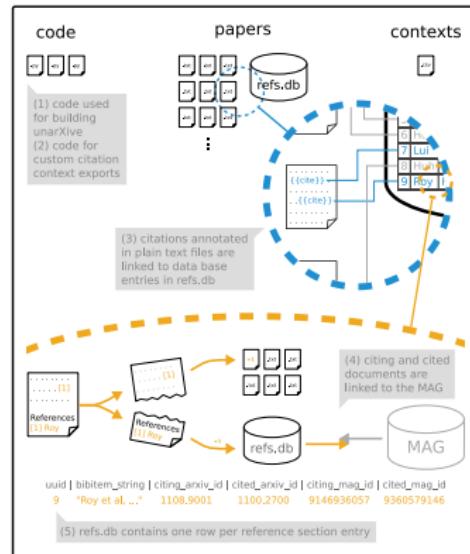
Develop a method for creating large-scale, high quality “base corpus”

■ Approach

- Conversion of / IE from \LaTeX
- Joint handling of text + references
- Reference parsing + linking to metadata records

■ Results

- Corpus among 3 largest full-text corpora
- More extensive, complete, less noisy data
- State of the art reference linking



Scientometrics'20 [1]

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Corpus - Challenges

■ General

- Volume ($\sim 10^6$ docs, $\sim 10^7$ refs)
- Bridging visual medium and text information

■ Parsing

- Parser efficiency
- Typesetting info \neq semantic info
- \LaTeX is powerful and people are creative

■ Reference linking

- Choice of target set
- Parsing (bb1, not bib)
- Variance and information sparsity

```
\begin{document}
\newcommand{\nc}{\newcommand}
\nc{\be}{\begin{equation}}
\nc{\ee}{\end{equation}}
\nc{\bib}{\bibitem}
```

[10] I. Bonalde et al., Phys. Rev. Lett. **85**, 4775 (2000).

[25] Bonalde I, Yanoff B D, Salomon M B, Van Harlingen D J, Chia E M E, Mao Z Q and Maeno Y 2000
Phys. Rev. Lett. **85** 4775

[4] Jaume, S.C. and Sykes, L.R., Pure and Applied Geophysics **155**, 279-305.

Jaume, S.C. and L.R. Sykes, Evolving Towards a Critical Point: A Review of Accelerating Seismic
Moment/Energy Release Prior to Large and Great Earthquakes, Pure Appl. Geophys., 155, 279, 1999.

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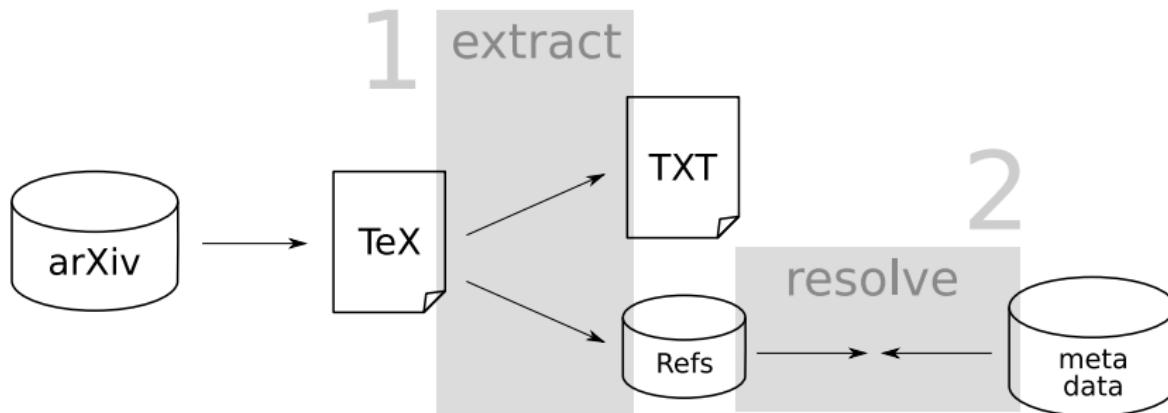
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Corpus - Solutions



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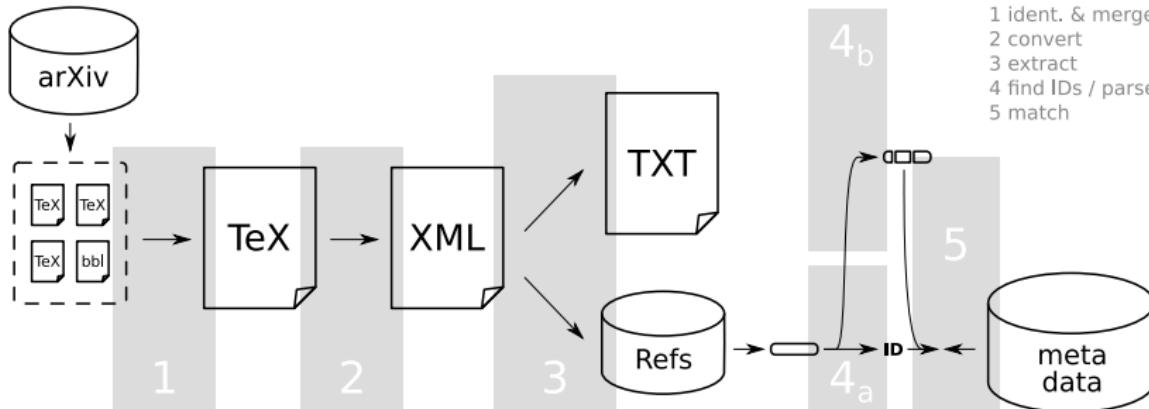
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Corpus - Result

■ Size

- 1.2 M documents (2.7 M cited)
- 16 M references
- 29 M in-text citation markers

■ Scope

- 1991–2018 (current: 2022)
- physics (63%), maths (23%), CS (11%), other (3%)

■ Reference matching

- 53% by parsing + matching
- 28% by DOI
- 19% by arXiv ID

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Corpus - Result

| Data set | # Docs | Cit. markers | Disciplines | Full text | Linked |
|-----------------------------|--------|--------------|------------------|-------------------|--------------------|
| ACL-ARC [2] | 11 k | no | comp. ling. | PDF | ✗ |
| ACL-AAN [3] | 18 k | no | comp. ling. | PDF | ✗ |
| Scholarly Dataset 2 [4] | 100 k | no | CS | PDF | ✗ |
| CiteSeerX [5] / RefSeer [6] | 1 M | ambiguous | mixed | 400 char excerpts | ✗ |
| PMC OAS [7] | 2.3 M | exact | biomedical | XML | mixed ^a |
| arXiv CS [8] | 90 k | exact | CS | text | ✓ |
| unarXive [1] | 1.2 M | exact | phys., maths, CS | text | ✓ |

^a No citation network due to mixed set of IDs (PubMed, MEDLINE, DOI) [9].

Corpus - Result (2022)

| Data Set | Source | | Citation Network ^a | | | # Docs | Disciplines |
|--|-----------|---|-------------------------------|--------------|--------------|--------|-------------------------|
| | Data | Format | general | compare | | | |
| CORE [10] | multiple | PDF | 0% | - | >100 M | | various |
| S2ORC (PDF) [11] | multiple | PDF | 69.4% | - | 12 M | | various |
| unarXive 2020 [1] | arXiv.org | L <small>A</small> T <small>E</small> X | 42.6% | 42.6% | 1.2 M | | phys., maths, CS |
| S2ORC (L <small>A</small> T <small>E</small> X) [11] | arXiv.org | L <small>A</small> T <small>E</small> X | 31.1% | 31.1% | 1.5 M | | phys., maths, CS |
| arXMLiv [12] | arXiv.org | L <small>A</small> T <small>E</small> X | 0% | 0% | 1.6 M | | phys., maths, CS |
| SciXGen [13] | arXiv.org | L <small>A</small> T <small>E</small> X | 41.6% | - | 205 k | | CS |
| PMC-OAS [7] | PubMed | XML | mixed ^b | - | 3.3 M | | biomedical |
| unarXive 2022 [14] | arXiv.org | L <small>A</small> T <small>E</small> X | 44.4% | 44.4% | 1.9 M | | phys., maths, CS |

^a “general”: all data; incomparable. “compare”: arXiv.org data 1991–2020; directly comparable.

^b No citation network due to mixed set of IDs (PubMed, MEDLINE, DOI) [9].

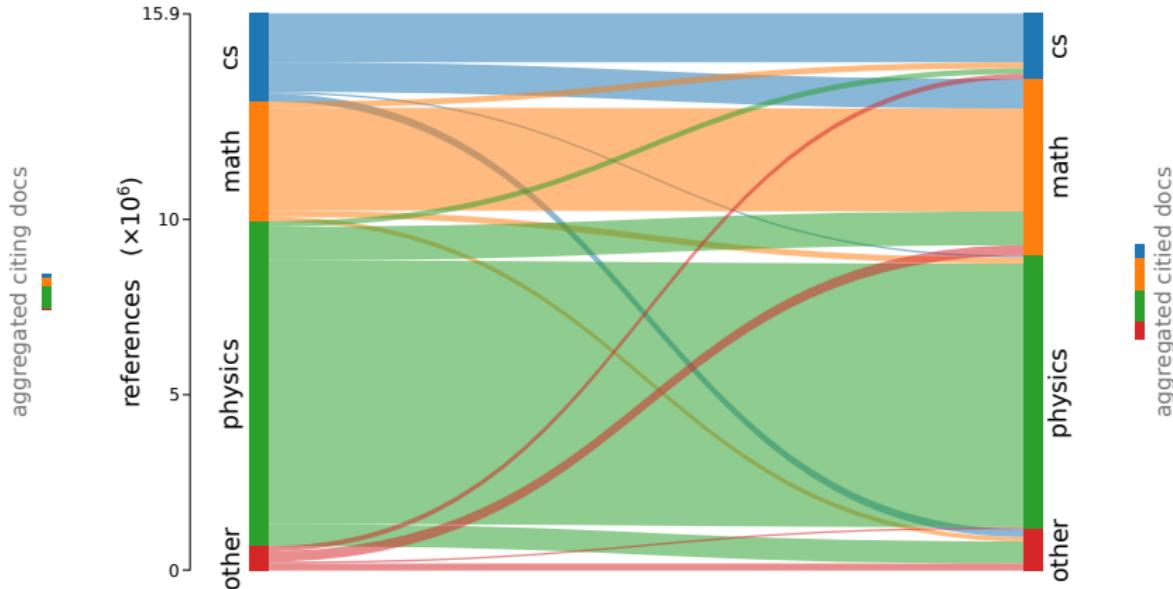
Corpus - Link Correctness

Table: Link correctness (n = 300)

| Confidence level | Method ^a | Lower limit | Upper limit |
|------------------|---------------------|-------------|-------------|
| 0.99 | Wilson | 0.9613 | 0.9975 |
| | Jeffreys | 0.9666 | 0.9983 |
| 0.95 | Wilson | 0.9710 | 0.9966 |
| | Jeffreys | 0.9736 | 0.9972 |

^a Confidence interval given as Wilson score interval and Jeffreys interval [15].

Corpus - Citation Flow



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Corpus - Conclusion

■ Advancements

- More extensive
 - single domain vs multi domain
- More complete, high quality citation network
 - 13.3% increase in linked references (\leftrightarrow S2ORC_{LATEX})
 - 4% more accurate reference links (\leftrightarrow S2ORC_{LATEX})
- Less noise due to LATEX as source
- Novel types of analyses possible

■ Foundation for further studies

- → RT1 ✓

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Citation Network - Digest

■ Research gap

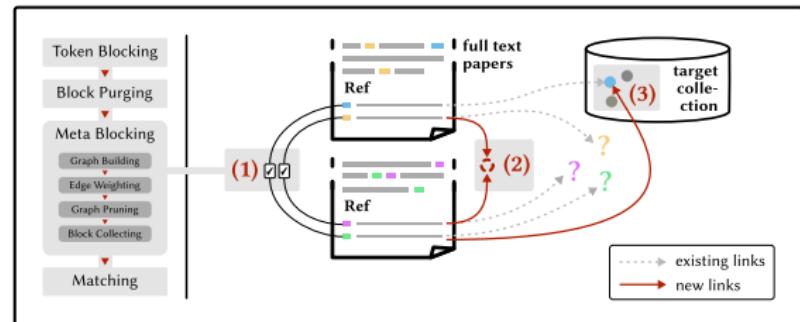
- Reference linking coverage
- Reliance on target data set

■ Approach

- Use unarXive data
- Improved reference parsing pipeline
- Blocking approach used within set of references

■ Results

- 2% increase in base matching success
- Manifold increase in bibliographic coupling matches



ULITE'22 [16]

JCDL'23 [14]

Motivation
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References

Non-English Documents - Digest

■ Research gap

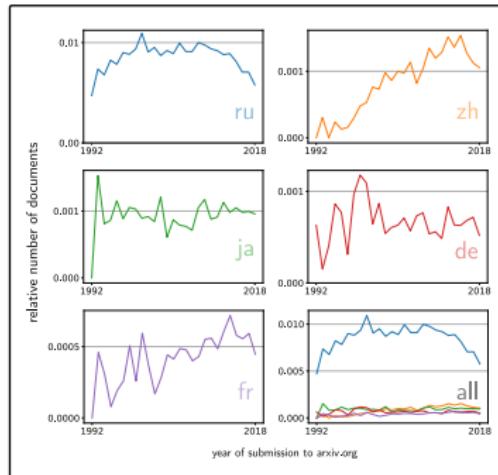
- Restriction of existing work to English
- Limited scale of existing studies

■ Approach

- Use unarXive data
- Document language from raw reference strings
- Temporal and geographic analyses

■ Results

- Reliable method for identification
- Largest study so far ($<1k \rightarrow >1M$)
- Identification of trends and challenges



ICADL'20 [17]

IJDL'22 [18]

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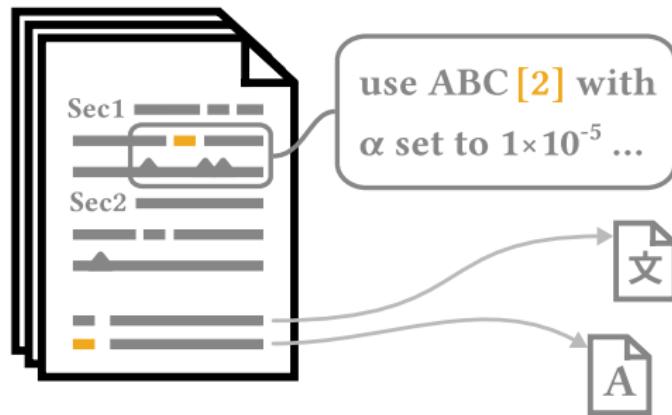
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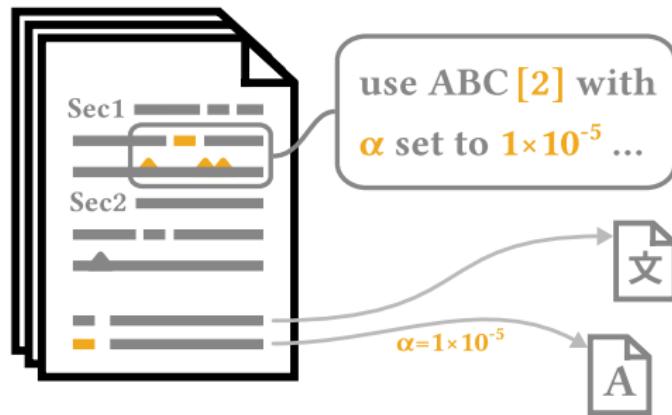
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References

Artifact Parameters



Artifact Parameters - Digest

■ Research gap

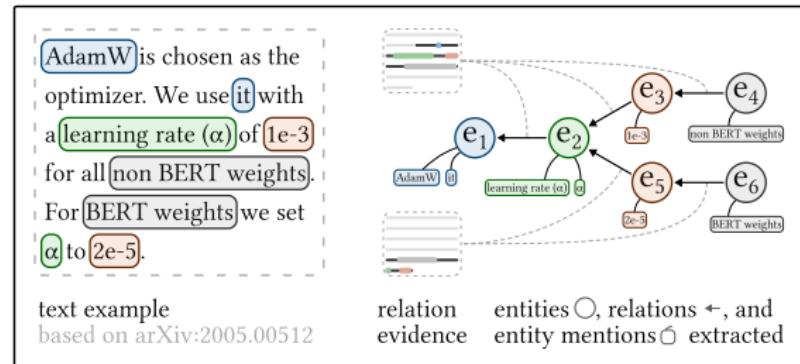
- Important information not considered
- Lack of link granularity
- No formalization/approaches

■ Approach

- Task formalization
- Data annotation (data from unarXive)
- Two lines of approaches
 - BERT based model approach
 - LLM based approach

■ Results

- Novel task, novel data
- Improvements over SOTA baselines



ECIR'24 [19]

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Artifact Parameters - Task Definition

■ Goal

- Automatically extract parameter information from paper text

■ Motivation

- Reproducibility indication [20], automation [21]
- Uncover conventions and trends
- More fine-grained paper representations (similarity measures, recommendation, search)

■ Task Type

- (Named) Entity Recognition, Relation Extraction

For ADAM, we set $\beta_2 = 0.999$

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Artifact Parameters - Scope & Annotation Scheme

- 4 entity classes
 - (1) research **artifact**: model, method, data set, ...
 - descriptions of how authors use the artifacts
 - (2) **parameter** (α , learning rate, k, ...)
 - (3) **value** (1e-3, five, $\frac{1}{3}$, ...)
 - (4) **context** (for fine-tuning, during grid search, ...)
- 1 relation type
- out of scope
 - measurements ("We obtain an AUC value of 0.75")

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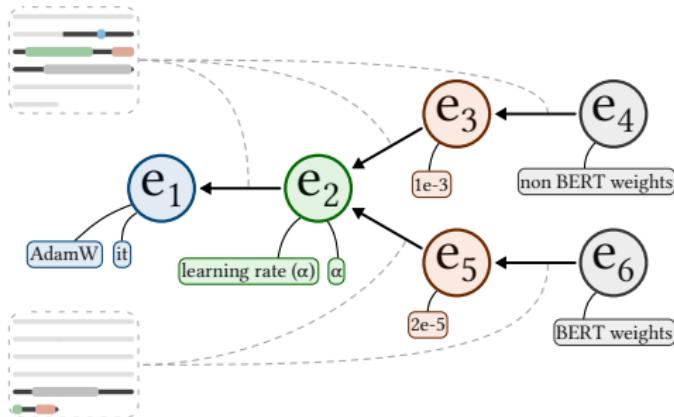
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Scope & Annotation Scheme

AdamW is chosen as the optimizer. We use it with a learning rate (α) of $1e-3$ for all non BERT weights. For BERT weights we set α to $2e-5$.

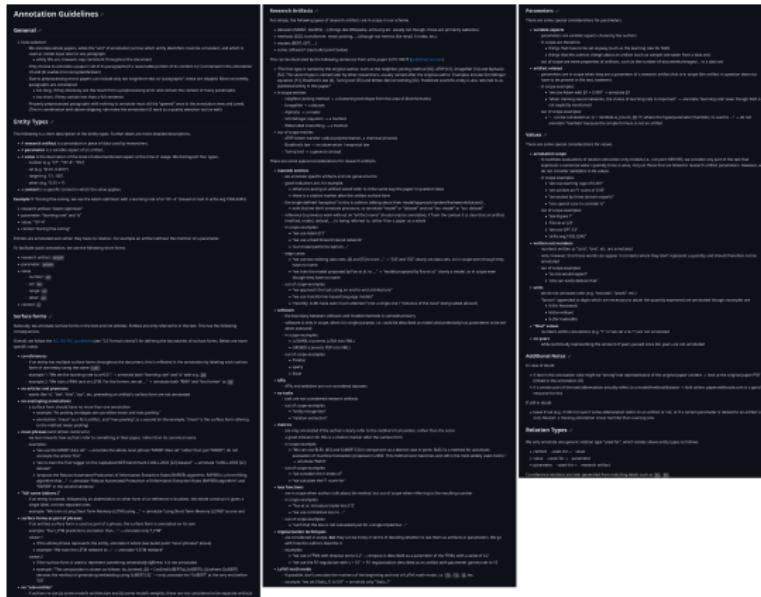
text example
based on arXiv:2005.00512



relation entities ○, relations ←, and
evidence entity mentions ◻ extracted

Artifact Parameters - Data

- Annotation approach
 - Guidelines based on ACL RD-TEC guidelines [22]
 - Paragraph level, whole papers
 - Extent
 - 444 paragraphs
 - 1,971 entities
(1,134 a, 131 p, 662 v, 44 c)
 - 614 relations
 - IAA
 - 0.867 for entities
 - 0.737 for relations



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Artifact Parameters - Data

- Annotation approach
 - Guidelines based on ACL RD-TEC guidelines [22]
 - Paragraph level, whole papers
- Extent
 - 444 paragraphs
 - 1,971 entities
 - (1,134 a, 131 p, 662 v, 44 c)
 - 614 relations
- IAA
 - 0.867 for entities
 - 0.737 for relations

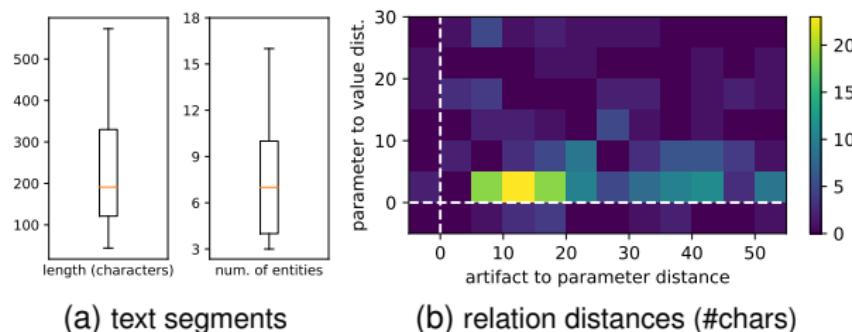


Figure: Observations of initial annotation round

Artifact Parameters - Related Work: Fine-tuned models

- SciERC dataset
 - SCIIE [23]
 - PL-Marker [24]
 - → overlap
- SciREX dataset
 - TempGen [25] (only RE)
- SemEval 2022 (math symb. to descr.)
 - JBUU-CCLab [26]
 - AIFB [27]
- SemEval 2021 (measurements)
 - LIORI [28]
 - → mention patterns

We evaluate our model on the task of **question answering** using

Section : Dataset

SQuAD is a **machine comprehension** dataset on a large set of **Wikipedia articles** , Two metrics are used to evaluate models: **Exact Match (EM)** and a softer metric , **F1 score**

Section: Model Details .

... Each paragraph and question are tokenized by a regular - expression - based word tokenizer (**PTB Tokenizer**) and fed into the model .
....

Section : Results .

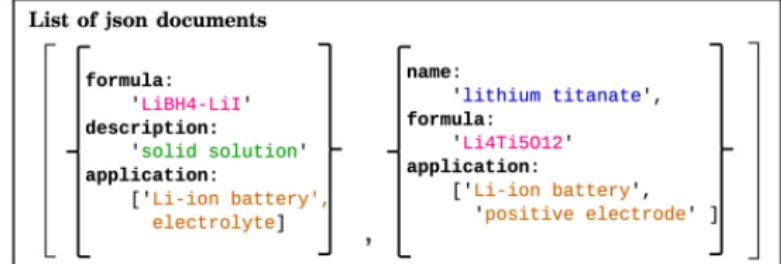
The results of our model and competing approaches on the hidden test are summarized in Table [reference]. **BiDAF { ensemble }** achieves an **EM** score of 73.3 and an **F1**-score of 81.1, outperforming all previous approaches .

Artifact Parameters - Related Work: LLMs

- Medical science [29]
 - singular values
 - lists
- Material science [30–32]
 - singular values
 - lists
 - complex [32] (see right)

Note: all of the above evaluate on GPT models only.

Document: The charge and discharge performance of an all-solid-state lithium battery with the LiBH4-LiI solid solution as an electrolyte is reported. Lithium titanate ($\text{Li}_4\text{Ti}_5\text{O}_{12}$) was used as the positive electrode and...



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Artifact Parameters - Approach

- **Fine-tuned, supervised**

- PL-Marker (SciERC SOTA)
- Mention pattern aware RE (ours)

- **LLM, zero-/few-shot**

- 6 models
- JSON approach (MatSci)
- YAML approach (ours)

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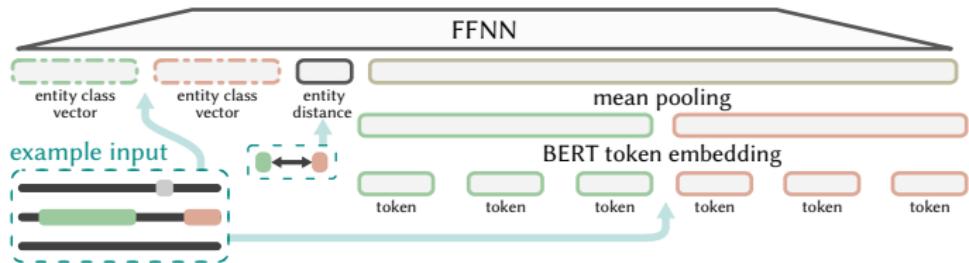
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Artifact Parameters - Methods: Fine-tuned models

- Based on PL-Marker
- New RE module
- Include entity class emb. + distance in model input



Artifact Parameters - Methods: LLMs

- Test various prompting techniques
 - Multi-stage
 - In-text annotation
 - Data serialization format ✓
- Compare 6 models
- Base prompt + tuning for each
- Few-shot only with Vicuna_{16k}

| Model | Variant | Size |
|----------------------------|---------------------|-------|
| WizardLM [33] | WizardLM-13B-V1.1 | 13 B |
| Vicuna _{4k} [34] | vicuna-13b-v1.3 | 13 B |
| Vicuna _{16k} [34] | vicuna-13b-v1.5-16k | 13 B |
| Falcon [35] | falcon-40b-instruct | 40 B |
| GALACTICA [36] | galactica-120b | 120 B |
| GPT-3.5 [37] | text-davinci-003 | 175 B |

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Artifact Parameters - Methods: LLMs

In the context of machine learning and related fields, what (if any) are the entities (datasets, models, methods, loss functions, regularization techniques) mentioned in the LaTeX Input Text below? What (if any) are their parameters and values?

```
[LaTeX Input Text start]
We use AdamW with a learning rate ($\alpha$) of 1e-3 for /* [...] */
[LaTeX Input Text end]
```

Answer in the following YAML format.

Format:

```
---
text_contains_entities: true/false
entities:
  - entity<N>:
    id: e<N>
    name: "<entity name>"
    type: dataset/model/method/loss function/regularization technique
    has_parameters: true/false
    parameters:
      - parameter<M>:
        id: p<N.M>
/* [...] */
...
```

Only include entities that are of type dataset, model, method, loss function, or regularization technique. Do not output entities that are of another type. Do not include entities of type task, metric, library, software, or API.

Only produce output in the YAML format specified above. Output no additional text.

Output:

Artifact Parameters - Experiments: Fine-tuned models

5-fold cross-validation, stratified sampling

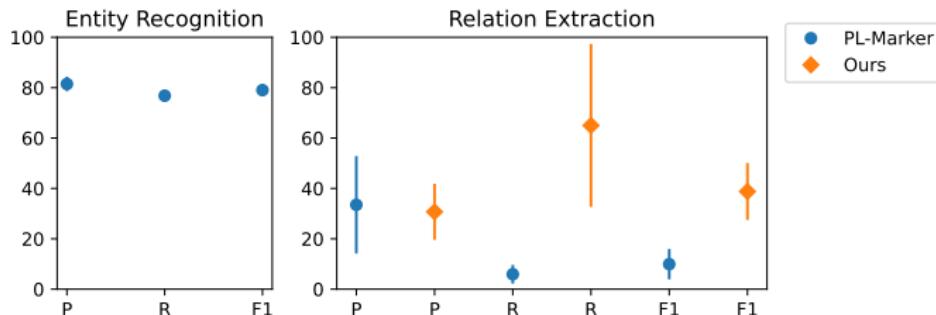


Table: Ablation study results (model inputs are: T = BERT token embeddings, C = entity class embeddings, D = entity distance)

| Used | P [%] | R [%] | F ₁ [%] |
|------------|-------------|-------------|--------------------|
| TCD | 15.5 | 8.8 | 11.1 |
| T,D | 16.6 | 29.8 | 19.6 |
| T,C | 26.5 | 65.0 | 35.5 |
| TCD | 30.7 | 65.0 | 38.8 |

Artifact Parameters - Experiments: LLMs

| Zero-shot | | Entity Recognition | | | Relation Extraction | | |
|-----------------------|--------|--------------------|-------------|-----------------------------|---------------------|-------------|----------------------------|
| Model | Output | P [%] | R [%] | F ₁ [%] | P [%] | R [%] | F ₁ [%] |
| WizardLM | JSON | 6.9 | 11.3 | 8.6 | 0.1 | 0.8 | 0.1 |
| | YAML | 9.7 | 35.6 | 15.3 _{△+6.7} | 0.1 | 1.5 | 0.1 _{△+0.0} |
| Vicuna _{4k} | JSON | 15.1 | 9.3 | 11.5 | 0.7 | 3.8 | 1.2 |
| | YAML | 17.3 | 31.5 | 22.3 _{△+10.8} | 0.0 | 0.8 | 0.1 _{△-1.1} |
| Falcon | JSON | 37.1 | 5.9 | 10.2 | 0.0 | 0.0 | 0.0 |
| | YAML | 32.7 | 14.2 | 19.8 _{△+9.6} | 0.0 | 0.0 | 0.0 _{△+0.0} |
| GALACTICA | JSON | 25.9 | 15.7 | 19.5 | 0.1 | 2.3 | 0.3 |
| | YAML | 23.1 | 19.5 | 21.1 _{△+1.6} | 0.0 | 0.8 | 0.1 _{△-0.2} |
| GPT-3.5 | JSON | 27.9 | 42.8 | 33.8 | 5.4 | 10.7 | 7.2 |
| | YAML | <u>34.0</u> | <u>41.7</u> | <u>37.4_{△+3.6}</u> | <u>5.8</u> | <u>12.2</u> | <u>7.8_{△+0.6}</u> |
| 5-shot | | Entity Recognition | | | Relation Extraction | | |
| Vicuna _{16k} | JSON | 34.4 | <u>46.7</u> | <u>39.6</u> | 0.8 | 4.6 | 1.3 |
| | YAML | 43.9 | 44.1 | 44.0_{△+0.4} | 4.5 | 9.9 | 6.1_{△+4.8} |

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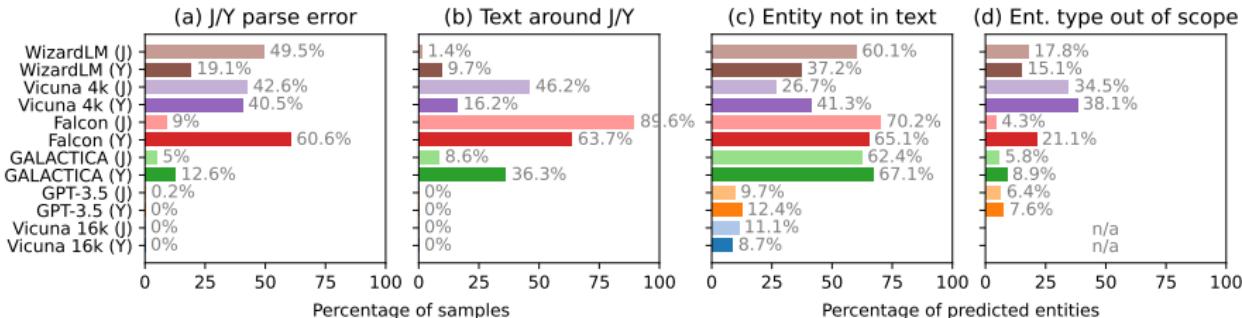
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Artifact Parameters - Experiments: LLMs



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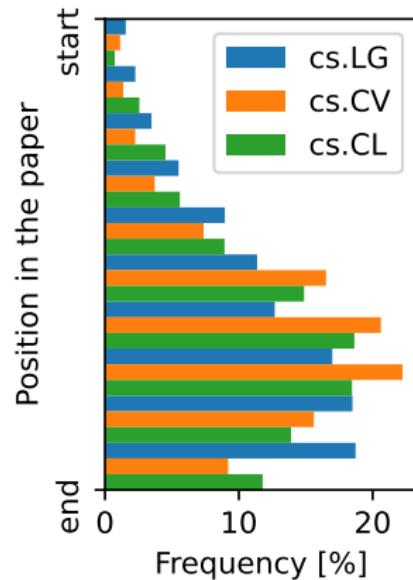
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References

Artifact Parameters - Experiments: Application

- Apply best model (BERT based) on 15k paper sample
- Parameters information given in
 - 36% of ML papers
 - 42% of CV papers
 - 36% of CL papers
 - 7% of DL papers
- Distribution towards second half of paper accross disciplines



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Artifact Parameters - Discussion

- Applicable on large scale
- LLMs not on par with BERT based model
- **Advancements**
 - Task formalization (scope, data scheme, annotation guidelines)
 - High quality manually annotated data set
 - BERT model based approach
 - 29% F_1 increase for RE
 - LLM approach
 - avg. 5.5% F_1 increase for NER
 - consistent across all LLMs

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Overall Conclusion



Research Objective

Develop methods for generating high-quality scholarly data.

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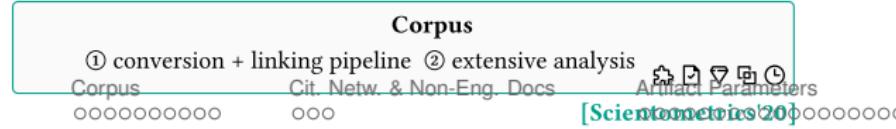
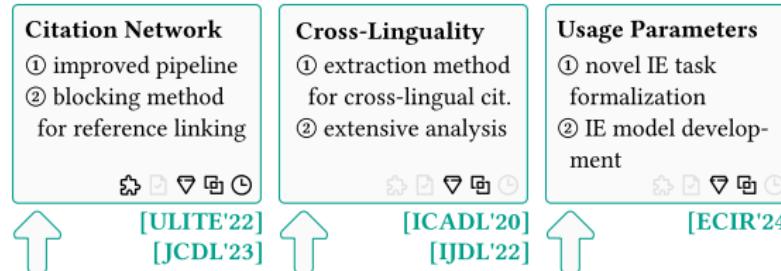
Overall Conclusion



Research Objective

Develop methods for generating high-quality scholarly data.

like this:



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Research Objective

Develop methods for generating high-quality scholarly data.

- Scholarly data from source formats
- Joint handling of docs & references
- Identifier aware references parsing
- Intra references clustering & matching
- Extraction of non-English content
- Identification of cross-lingual references from raw references
- Extraction of usage parameters from full text
- Mention pattern aware relation extraction

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Overall Conclusion

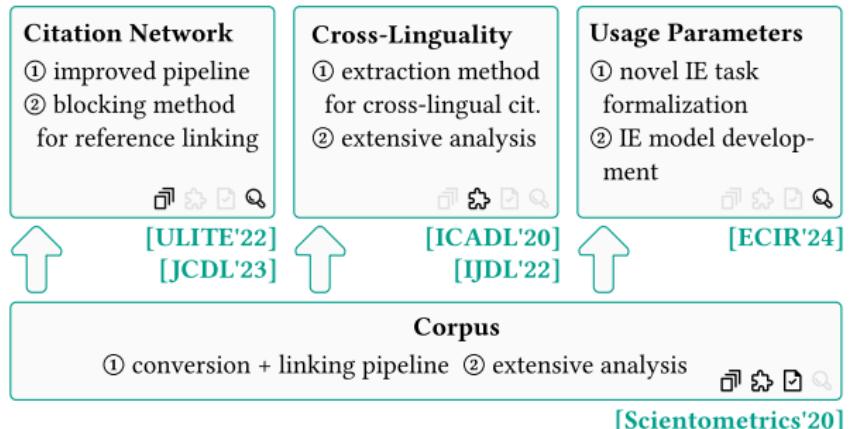
■ Big Picture

- Corpus creation method
- Advances in three focus areas
 - Citation Network
 - Non-English Documents
 - Artifact Parameters

■ Improved

- Volume
- Completeness
- Correctness
- Granularity

■ Impact on research community



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References

Impact

Adoption by the research community.

■ Methodology

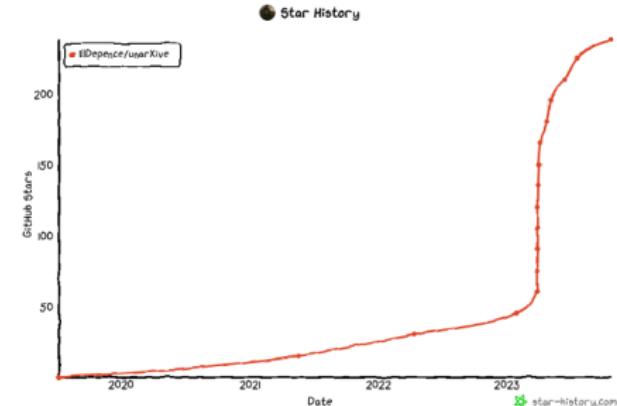
- Document Parsing Methodology [11]

■ Model dev/eval

- Citation Recommendation [38] ([39, 40])
- Citation Analysis [41, 42] ([17, 18])
- Document Retrieval [43]
- Researcher Profile Embeddings [44]
- Reference Linking ([16])

■ Dataset extension

- Link Prediction ([45])
- NER+RE ([19])



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References

Thank You ☺

Questions?

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References

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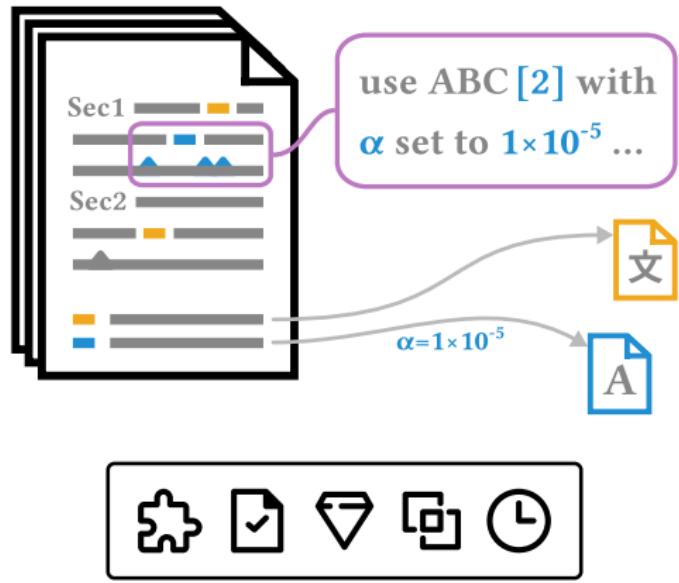
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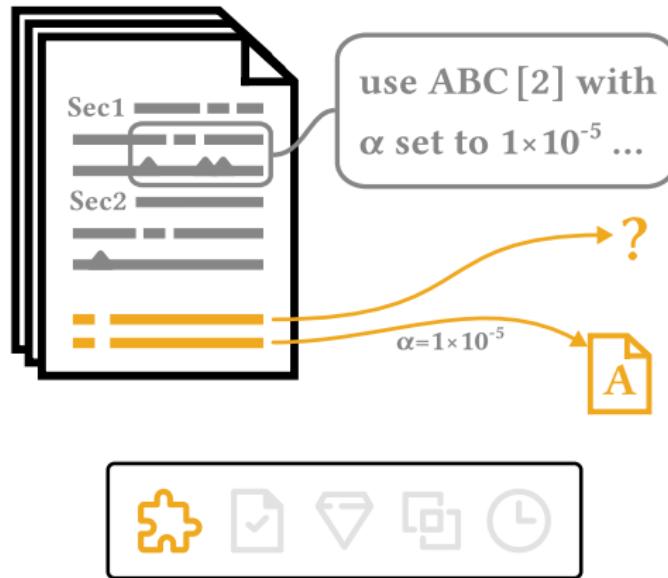
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Extra Slides

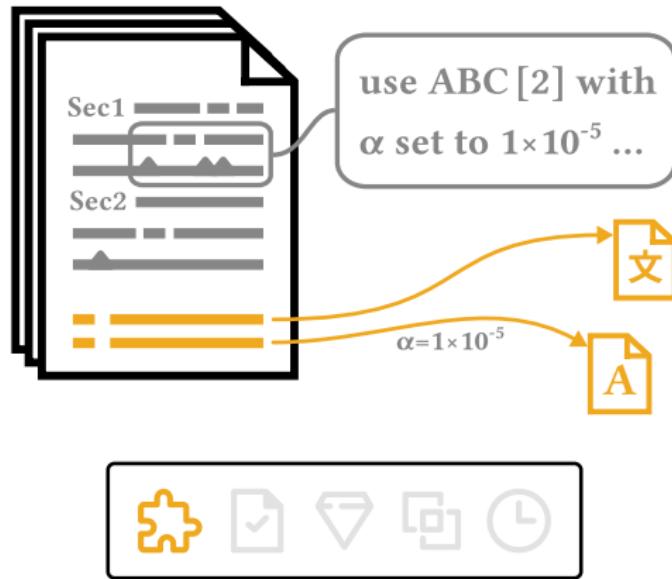
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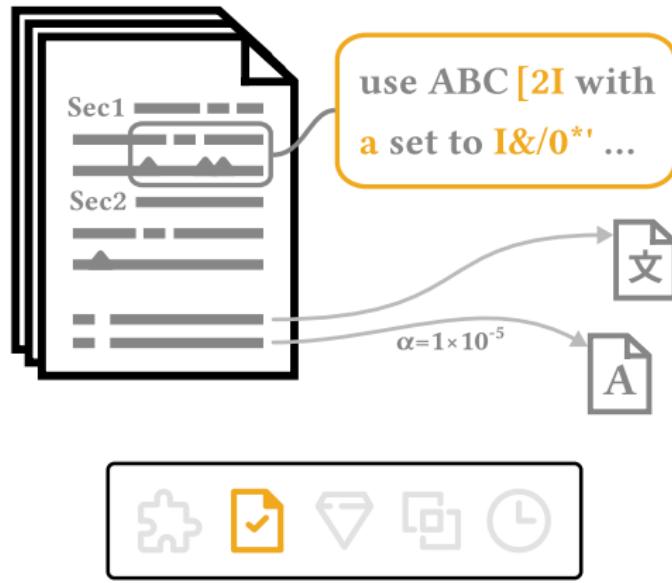
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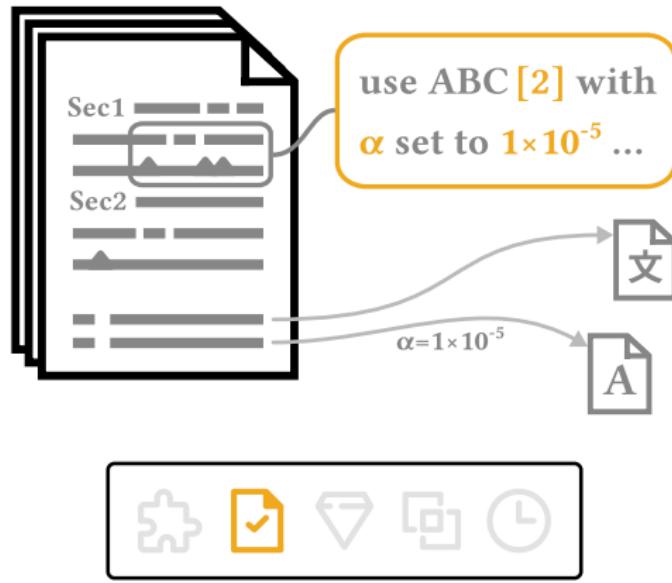
Quality Dimensions: Completeness



Quality Dimensions: Accuracy



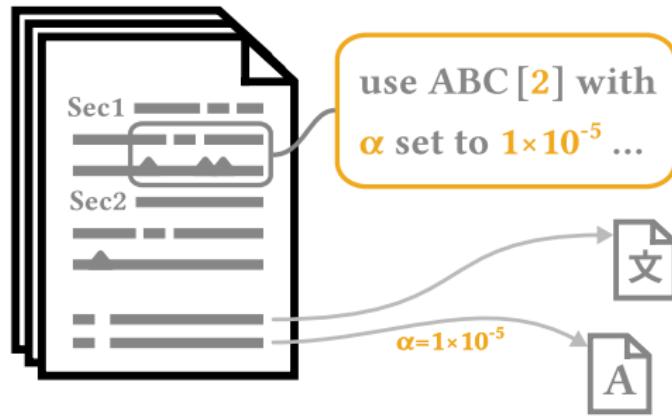
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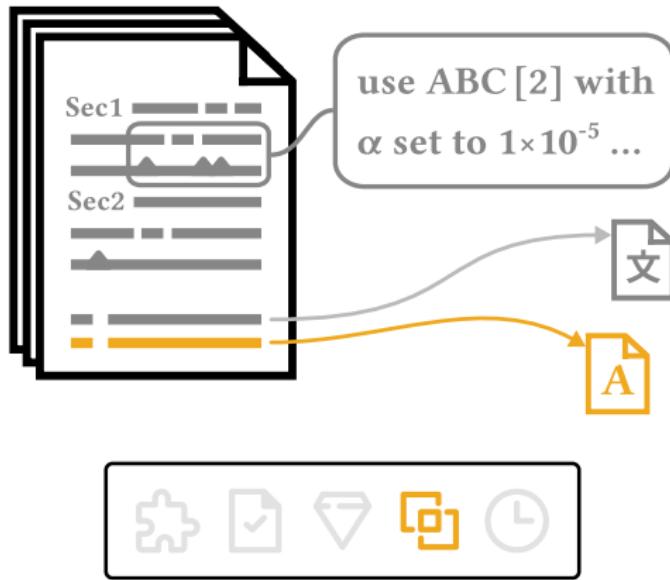
Quality Dimensions: Relevance



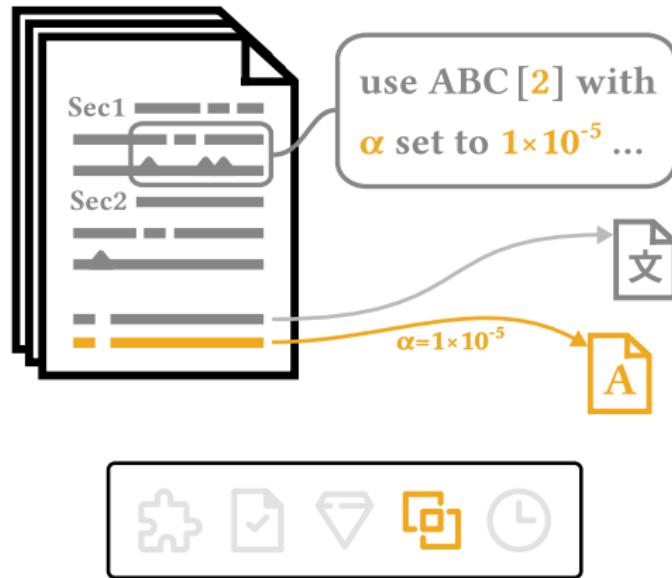
Quality Dimensions: Relevance



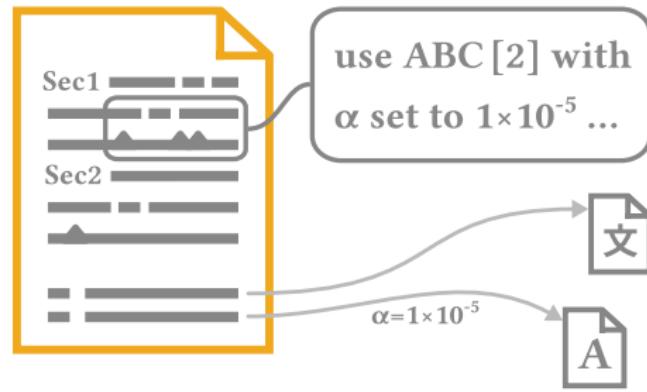
Quality Dimensions: Comparability



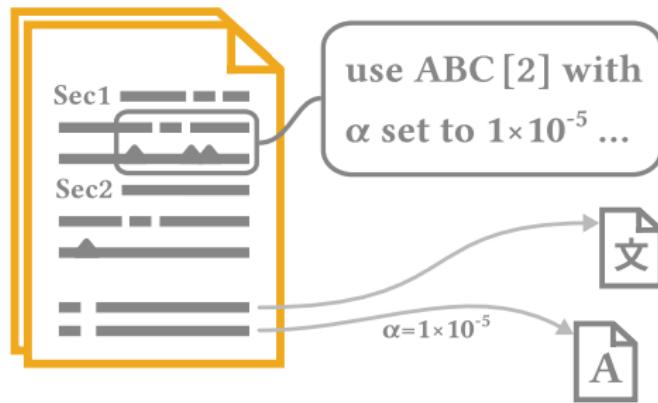
Quality Dimensions: Comparability



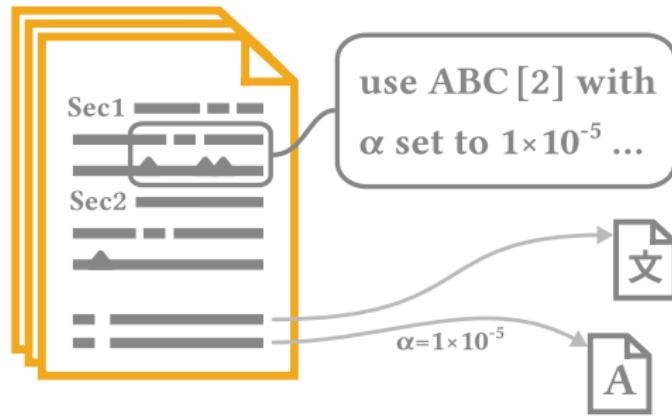
Quality Dimensions: Timeliness



Quality Dimensions: Timeliness



Quality Dimensions: Timeliness



Corpus - Stats

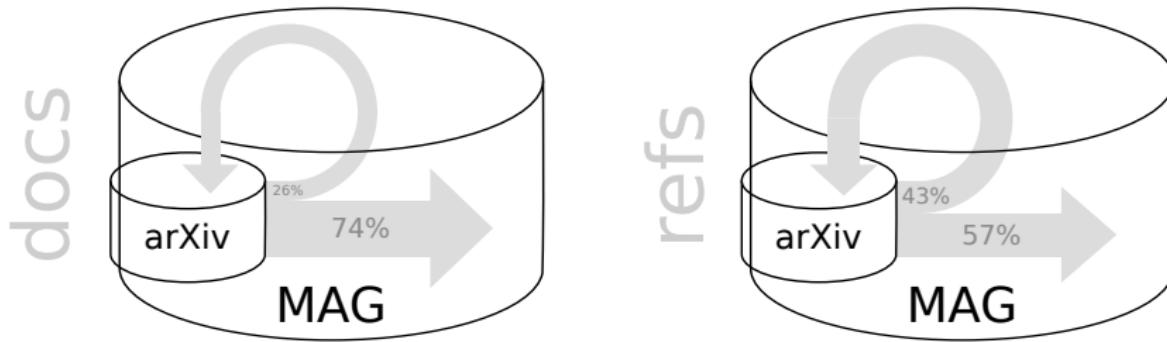
| | citing documents | references | cited documents | |
|-----------------------|---------------------|-------------------|--------------------|------------------|
| | | | outgoing | incoming |
| <i>full data set:</i> | 1,043,126 | 15,954,664 | 15,954,664 | 2,746,288 |
| full text | 1,043,126 | 15,954,664 | 7,181,576 | 736,597 |
| linked to MAG | 994,351 | 15,846,351 | 15,954,664 | 2,746,288 |
| <i>by discipline:</i> | | | | |
| physics | 662,894 | 9,300,576 | 7,827,072 | 921,852 |
| mathematics | 237,422 | 3,426,117 | 5,062,033 | 906,301 |
| computer science | 111,694 | 2,526,656 | 1,876,401 | 425,860 |
| other | 31,116 | 701,315 | 1,189,158 | 492,275 |

data: <http://doi.org/10.5281/zenodo.3385851>

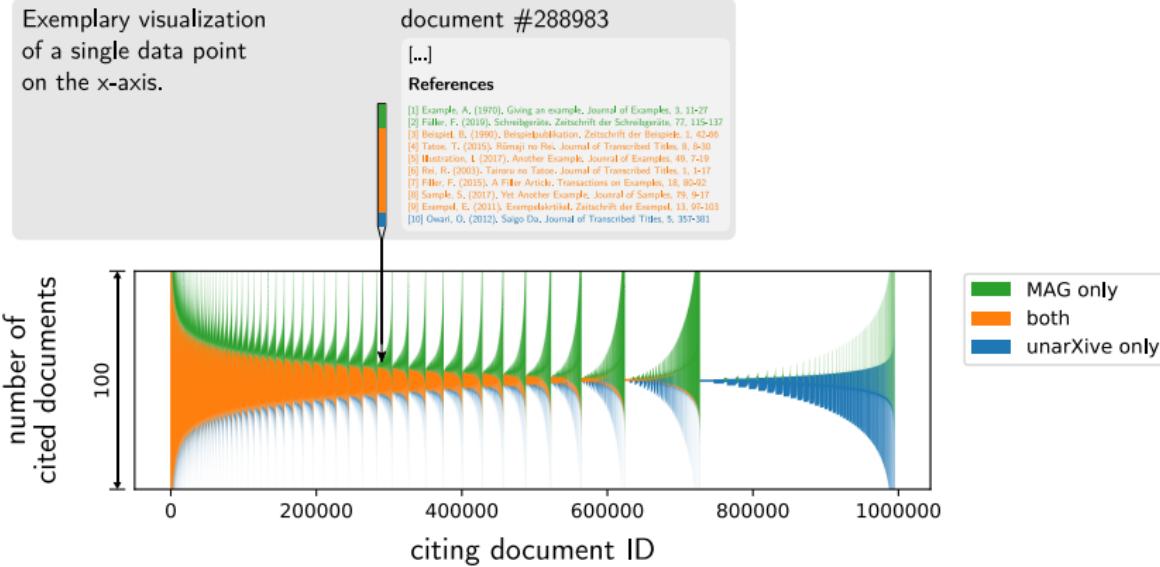
code: <https://github.com/IllDepence/unarXive>



Corpus - Citation Flow



Corpus - Reference Composition



Corpus - Target Sec. Specific Refs

| | Discipline ^a | Count | Normalization factor | Normalized ratio (%) |
|---------------|--|---------|----------------------|----------------------|
| Citing | Mathematics | 298,009 | 4.66 | 8.70 |
| | CS | 9,123 | 6.31 | 0.36 |
| | Physics | 30,593 | 1.72 | 0.33 |
| Cited | Mathematics | 313,651 | 3.15 | 6.20 |
| | CS | 12,179 | 8.50 | 0.65 |
| | Physics | 31,087 | 2.04 | 0.40 |
| Pairs | <u>Math[†]→Math[‡]</u> | 200,859 | 5.41 | 6.81 |
| | <u>Math[†]→CS</u> | 5,134 | 92.13 | 2.96 |
| | <u>Math[†]→Phys</u> | 3,114 | 89.88 | 1.75 |
| | <u>CS→Math[‡]</u> | 3,456 | 18.82 | 0.41 |
| | <u>Phys→Math[‡]</u> | 3,859 | 16.49 | 0.40 |
| | <u>CS→CS</u> | 2,500 | 11.38 | 0.18 |
| | <u>Phys→Phys</u> | 10,374 | 2.12 | 0.14 |
| | <u>CS→Phys</u> | 50 | 307.16 | 0.10 |
| | <u>Phys→CS</u> | 137 | 101.40 | 0.09 |

^a [†]: Mathematics citing document, [‡]: Mathematics cited document, X→X: Citing and cited document are from the same discipline.



Artifact Parameters - Motivation

Jurgens, D. et al. Measuring the Evolution of a Scientific Field through Citation Frames. *Transactions of the Association for Computational Linguistics* 6, 391–406 (2018)

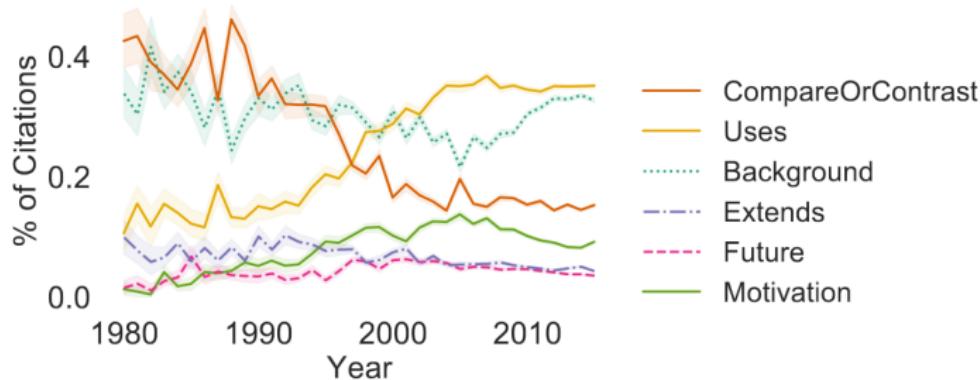


Figure 5: Changes in the average citation frame in ACL papers reveals a continued decline in the percentage of COMPARISON OR CONTRAST and increase in USES citations. The increase in BACKGROUND citations circa 2010 marks the start of the era of unlimited references in ACL conferences. Shaded regions show bootstrapped 95% confidence intervals.



Artifact Parameters - Motivation

The screenshot shows the homepage of the Dagstuhl Artifacts Series (DARTS) website. At the top, there is a navigation bar with links to THE INSTITUTE, SEMINARS, PUBLISHING, DBLP, GUEST INFORMATION, and CONTACT. On the right side of the navigation bar are search fields, a magnifying glass icon, and language links for EN and DE. Below the navigation bar is a logo for "DAGSTUHL ARTIFACTS SERIES" featuring a stylized yellow 'W' icon. The main title "Dagstuhl Artifacts Series (DARTS)" is centered above a horizontal menu bar with tabs: GENERAL, EDITORIAL BOARD, SELECTION/REVIEW, AUTHOR INSTRUCTIONS, EDITOR INSTRUCTIONS, and RECENTLY PUBLISHED. A vertical orange sidebar on the right is titled "QUICK LINKS". The main content area contains several sections: "Publications" (linking to the DARTS webportal), "Aims and Scope" (describing the series as a periodical of one volume per year focused on special issues related to a conference), and "Open Access Policy" and "License" (both stating that artifacts are peer-reviewed, published online, and available under a Creative Commons CC BY license). There is also a note about the artifact descriptions being published under a Creative Commons CC BY license.

THE INSTITUTE SEMINARS PUBLISHING DBLP GUEST INFORMATION CONTACT

Search EN DE

DAGSTUHL ARTIFACTS SERIES

Dagstuhl Artifacts Series (DARTS)

GENERAL EDITORIAL BOARD SELECTION/REVIEW AUTHOR INSTRUCTIONS EDITOR INSTRUCTIONS RECENTLY PUBLISHED

The *Dagstuhl Artifacts Series (DARTS)* publishes evaluated research data and artifacts in all areas of computer science. An artifact can be any kind of content related to computer science research, e.g., experimental data, source code, virtual machines containing a complete setup, test suites, or tools. In contrast to existing repositories for research data and artifacts like [Zenodo](#) or [figshare](#), DARTS focuses on artifacts that underwent an evaluation process before their publication.

An artifact should be related to a research paper (which does not necessarily have to be published within a series of Dagstuhl Publishing but which should be clearly citable, e.g., by a DOI) and should help to verify the repeatability and correctness of the experiments/implementations described in the related paper.

The series is organized as a periodical consisting of one volume per year. Each volume can consist of several issues. Thereby, DARTS currently focuses on special issues that are related to a conference.

Publications [DARTS webportal](#): Archive of all published DARTS volumes.
[DARTS @ dblp](#)

Aims and Scope The DARTS series aims at the provision of a publication venue for evaluated research data and artifacts. An artifact can be any kind of content related to computer science research, e.g., experimental data, source code, virtual machines containing a complete setup, test suites, or tools. In contrast to existing repositories for research data and artifacts, DARTS focuses on artifacts that underwent an evaluation process before their publication.

The scope of DARTS covers all areas of computer science.

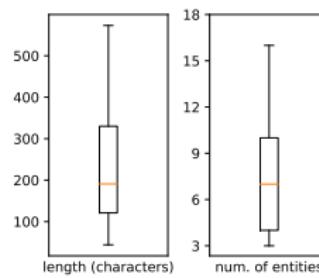
Open Access Policy Artifacts in DARTS are peer-reviewed and are published electronically according to the principles of open access, i.e., they are available online and free of charge.

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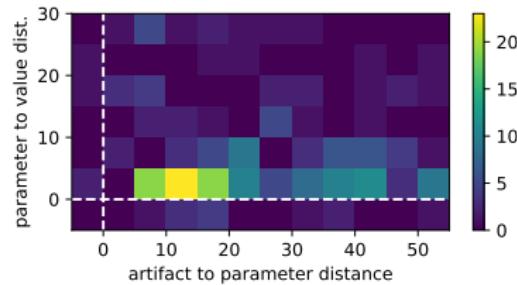


Artifact Parameters - Data

- Two annotation rounds
- Initial (pre-filtered text, exploratory, to fine-adjust scheme)
 - 151 text segments
 - 1,345 entities
 - 1,110 relations
- Main (full papers, eval data)
 - 444 paragraphs
 - 1,971 entities
(1,134 a, 131 p, 662 v, 44 c)
 - 614 relations
- IAA
 - 0.867 for entities
 - 0.737 for relations



(a) text segments



(b) relation distances (#chars)

Figure: Observations of initial annotation round



Publications - primary

| Chap. | Venue | Year | Type | Length | Author Position | Venue Rating | Ref. |
|-------|----------------|------|------------|--------|-----------------|--------------|------|
| 3 | Scientometrics | 2020 | Journal | Full | 1 of 2 | SJR Q1 | [1] |
| 4 | JCDL | 2022 | Workshop | Full | 1 of 3 | Core A* | [16] |
| | JCDL | 2023 | Conference | Short | 1 of 3 | Core A* | [14] |
| 5 | ICADL | 2020 | Conference | Full | 1 of 2 | Core A | [17] |
| | IJDL | 2022 | Journal | Full | 1 of 3 | SJR Q2 | [18] |
| 6 | ECIR | 2024 | Conference | Full | 1 of 4 | Core A | [19] |

Venue ranks from Core¹ (conferences) and SJR² (journals).³

¹See <http://portal.core.edu.au/conf-ranks/> (last accessed 2023-10-12).

²See <https://www.scimagojr.com/> (last accessed 2023-10-12).

³Ratings for publication year or, if not listed, most up-to-date ranking. Workshops ranks are that of the hosting conference.



Publications - secondary

| Venue | Year | Type | Length | Author Position | Venue | Ref. |
|-------|------|------------|--------|-----------------|---------|------|
| ECIR | 2019 | Workshop | Full | 1 of 2 | Core A | [39] |
| ECIR | 2020 | Conference | Full | 1 of 3 | Core A | [47] |
| NAACL | 2021 | Workshop | Short | 3 of 4 | Core A | [48] |
| AAAI | 2022 | Workshop | Full | 2 of 3 | Core A* | [49] |
| JCDL | 2022 | Conference | Full | 3 of 3 | Core A* | [50] |
| JCDL | 2023 | Conference | Short | 1 of 3 | Core A* | [45] |

Additional publications (co-)authored leading up to and during the research period which are not a direct part of the dissertation, but nevertheless informed the overall research trajectory. Especially [39] and [48], which constitute the results of the master's thesis preceding the doctoral research period, paved the way for the dissertation.



Limitations

- **Corpus**

- L^AT_EX required (no humanities)

- **Citation Network**

- Blocking method scalability

- **Non-English Documents**

- Single “direction”
 - Dependency on author notation

- **Artifact Parameters**

- IE from text, not tables, code, etc.
 - ML specific
 - English only

