

Die Hard 1.1024.0: Backward compatibility of a search engine with persistent IDs



seit 1558



deRSE19 - Conference for Research Software Engineers in Germany, 2019-06-04

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Background

The Hexatomic project

“A minimal infrastructure for the **sustainable** provision of extensible *multi-layer annotation software for linguistic corpora*”

- Funded under the call “Research Software Sustainability” issued by DFG under grant number GA 1288/11-1
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- Thomas Krause: computer scientist who slipped into linguistics
- Stephan Druskat: English M.A. turned software developer & computer scientist
- Both: Research Software Engineers

ANNIS and its query language

Web browser-based search and visualization architecture for *linguistic corpora* with diverse types of *annotation*. Part of the corpus-tools.org collection of tools for linguists. (Druskat et al. 2016)

The screenshot displays the ANNIS web interface. On the left, a sidebar contains a 'Query Builder' with a query: `"Pharmakonzern" | pos=V.FIN /->dep[func="sb"] | "Jugendliche" & cat="S" & #4 >secede #3`. Below this is a 'Corpus List' table with columns for Name, Texts, and Tokens. The main area shows search results for 'Pharmakonzern' with a list of tokens: 'darüber streiten', 'was', 'Jugendliche wollen', 'und brauchen', 'ohne auf die Idee'. Below the tokens, there are three visualizations: 'dependencies (arcs)' showing arcs between tokens, 'Information structure (grid)' showing a grid of annotations, and 'discourse references (grid)' showing a grid of annotations. At the bottom, there is a 'constituents (tree)' showing a tree structure of the sentence.

- Annotations are structured information added to text represented as a **graph with labels**
- Used by expert users (linguists) to **find and analyze linguistic phenomena**
- ANNIS allows finding annotations and *combinations* of annotations with its domain specific query language AQL
- AQL describes **nodes labels** and **joins them with operators**, which constrain the relation of the nodes in the graph

Semantic Versioning

- Popularized by semver.org (Preston-Werner n.d.)
- Explicit statement about compatibility between versions of API
- *MAJOR.MINOR.PATCH*
 - Only bug fixes when *PATCH* changes, API does not change
 - Additions to API marked as increase of *MINOR*
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- What is part of the API in a complex piece of software with multiple components?
 - REST API?
 - Query language?
 - Data exchange format?
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 - User Interface?
- Do we want to backward-compatible forever? Is there a “1.0 release anxiety”?

Persistent identifiers (PIDs)

What do I mean exactly when I refer to the “ANNIS software”?

<http://corpus-tools.org/annis/> <https://github.com/thomaskrause/ANNIS/>?

<https://github.com/korpling/ANNIS/>? Version 3.5.1? Version 4?

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- **Should never change**, i.e., you can print it in a book!
- Several systems exist, e.g. DOI, handle.net, ...

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Some open questions:

- If a digital resource moves, who updates the reference?
- Who provides and funds the infrastructure?

Achieving backward compatibility in ANNIS 4

ANNIS reference links

- ANNIS allows generating short links to query results and single matches, e.g., <https://korpling.org/annis3/?id=813c3146-2d10-4d0c-8a1f-1b5efc3c051a>

[✱ Show in ANNIS search interface](#)

| | | | | | | | | |
|--------------|------|-----|------|-----|-------|--------|-----|---|
| dipl | daſz | mir | GOtt | das | Glück | gön̄ | net | , |
| clean | dasz | mir | GOtt | das | Glück | gönnet | | , |
| norm | dass | mir | Gott | das | Glück | gönnt | | , |

- Glorified URL shortener: expands to a longer URL encoding the match and the actual query parameters, e.g., [https://korpling.org/annis3/#_q=bm9ybT0vZ8O2bm50Lw&_c=UklER0VTX\[...\]](https://korpling.org/annis3/#_q=bm9ybT0vZ8O2bm50Lw&_c=UklER0VTX[...])
- Query is executed each time the link is opened, no result identifiers are saved

Backward compatibility

Problem:

- ANNIS 3: AQL queries are mapped to SQL queries and executed by PostgreSQL
- ANNIS 4: custom in-memory graph-based search engine written in Rust, which directly executes AQL (Krause 2019)

All old reference links should still work because the query results are part of the research results.

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Solution 2: Make sure that each query that has been referenced, produces the same result in ANNIS 4 as in ANNIS 3

- Execute each referenced query on both ANNIS 3 and 4
- Compare the results
- If successful: Migrate the links to the new ANNIS 4 installation

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Other examples:

- Internet Explorer
- Rust language “editions” for opting in into breaking-change features

“We can’t get rid of it because we have a commitment to not breaking users’ code. There will not be a Rust 2.0.” – Steve Klabnik

(<https://news.ycombinator.com/item?id=19638000>)



Selected problems from the migration process

Formalized semantics of the data model and the query language

- In an ideal world a query language is formally defined like Datalog (Ceri, Gottlob, and Tanca 1989)
 - Strictly based on predicate logic
 - Declaration of so-called facts and rules how to infer new facts
- All you need to restore a digital object would be the data and any implementation conforming to the specification

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Real world: SQL

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Real world: SQL

- SQL versions have been standardized (... , SQL-93, SQL:1999, SQL:2003, ...)
- Various implementations (MySQL, PostgreSQL, Oracle, DB2, SQLite, ...) with different support for the standard and vendor extensions
- AQL has only two implementations, but the first implementation inherited semantics of SQL and its implementation in PostgreSQL
- Problems of changing AQL implementations are similar to those in **migrating an application from one SQL implementation to another**

Un-implemented functions of the query language

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- Check stored reference links to make it transparent if a query language feature has actually been used, and therefore needs emulation
- If too hard to implement:

Unsupported query for citation link

The query referenced by the citation link you followed is not supported properly by this version of ANNIS. We are sorry for the inconvenience and ask you to file a bug report at <https://github.com/korpling/ANNIS/issues> with the original citation link and where you found it.

If you want, you can still try to execute the query. This will probably give you different results than the ones originally referenced by this link or not even give any results at all.

I understand the risks, execute the query nevertheless.

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- Each node in the graph has a URI and an internal identifier
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- Spaces, slashes, umlauts, ...
- Double percent-escaped characters
- Everything Unicode has to offer

To invoke the hive-mind representing chaos...

<https://github.com/minimaxir/big-list-of-naughty-strings>

→ Importing data via IDs – and comparing them – is hard

Regular expressions

Regular expressions are an important part of AQL for matching node and edge labels

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```
-- PostgreSQL
SELECT * FROM t WHERE a ~ 'val.*';
-- MySQL
SELECT * FROM t WHERE a REGEXP 'val.*';
```

- Syntax varies from each implementation, even if “supporting POSIX”
- Regular expression engines often allow a search for non-regular expressions, such as backreferences and other extensions: some implementations trade features for speed (e.g RE2 from Google)
- “Power users” will use all regular features available, even if never officially documented

String ordering/collation

For query results, the order of the results is important, e.g. when referring to matches
→ ANNIS 4 reference migration checks order of the matches as well

What is the result of the following SQL query?

```
SELECT '_' < '-' ;
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What is the result of the following SQL query?

```
SELECT '_' < '-' ;
```

- Depends on your localization! LANG=C != LANG=en_US.UTF-8 != LANG=de_DE.UTF-8
- PostgreSQL allows to configure the collation for a column of a table explicitly

```
CREATE TABLE test1 (a text COLLATE "de_DE");
```

Anyone ever defined their tables this way *before* having collation issues in production?

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 - Unsupported binary operators (might not fix)
 - Actual bugs

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- Issues remaining
 - Unsupported regular expression features
 - Unsupported binary operators (might not fix)
 - Actual bugs
- Having these reference links gives us a huge **real world test set**
- **Automatic migration** for persistent IDs
- **Transparency** for the **administrator** which queries she/he can migrate to a new instance
- **Transparency** for the **end-user** if a query is known not to work, no silent failure
- We will be able to **retire ANNIS 3** while keeping all these reference links valid

Appendix

References

Ceri, Stefan, Georg Gottlob, and Letizia Tanca. 1989. “What You Always Wanted to Know About Datalog (and Never Dared to Ask).” *IEEE TRANSACTIONS KNOWLEDGE AND DATA ENGINEERING* 1 (1): 146–66.

Druskat, Stephan, Volker Gast, Thomas Krause, and Florian Zipser. 2016. “Corpus-Tools.org: An Interoperable Generic Software Tool Set for Multi-Layer Linguistic Corpora.” In *Proceedings of the Tenth International Conference on Language Resources and Evaluation (LREC 2016)*, edited by Nicoletta Calzolari (Conference Chair), Khalid Choukri, Thierry Declerck, Sara Goggi, Marko Grobelnik, Bente Maegaard, Joseph Mariani, et al. Portorož, Slovenia: European Language Resources Association (ELRA). http://www.lrec-conf.org/proceedings/lrec2016/pdf/918_Paper.pdf.

Krause, Thomas. 2019. “ANNIS: A Graph-Based Query System for Deeply Annotated Text Corpora.” Doctoral Dissertation, Humboldt-Universität zu Berlin, Mathematisch-Naturwissenschaftliche Fakultät. <https://doi.org/10.18452/19659>.

Preston-Werner, Tom. n.d. “Semantic Versioning 2.0.0. Semantic Versioning.” Accessed May 28, 2019. <https://semver.org/>.