cqp4rdf: Towards a Suite for RDF-based Corpus Linguistics

Maxim Ionov — ionov@informatik.uni-frankfurt.de
Florian Stein — flo@stein-software.com
Sagar — sagar.r16@iiits.in
Christian Chiarcos — chiarcos@informatik.uni-frankfurt.de

1. RDF corpora

- Linguistic corpora are collections of texts with annotations: morphological, syntactic, semantic, etc.
- There are myriads of ways to store and query corpora, as well as many tagsets even for the same language and the same type of annotation
- Classic ways of corpora representation → low level of inter-operability:
  - between different corpora
  - between corpora and other linguistic resources: dictionaries, thesauri, etc.
- Representing corpora as Linguistic Linked (Open) Data in RDF has many advantages
  - incorporation of any type of annotation on any stage of corpus development
  - harmonising annotations between tagsets and storing multiple annotations for the same data
  - linking to external resources, e.g. OntoLex-lemon dictionaries
- There are standards and evidence of *representing* corpora as Linked Data (NIF, CoNLL-RDF) but not of *using* it.
- Possible reason — the lack of user-friendly ecosystem.
- `cqp4rdf` is a **first step** on the way of **creating the ecosystem for corpus-based linguistic research using LLOD corpus resources**.

2. CQP query language

- CQP is a well-established and widely used query language for corpora.
- Ideal for extracting sequences of tokens with specific properties, i.e. *a sequence of adjectives followed by one noun*.
- The syntax is simple and concise:
  - Each token is denoted as `[]`. Quantifiers such as `+`, `*`, `?`, `{n, m}` can be applied: `[]{1,10}`.
  - Tokens can be filtered by their properties: `[word="comment" and pos="V"]`. String values are regular expressions: `[pos="V.*"]`.
  - Segments are denoted in XML-style: `<tag-name/>` and are usually used in combination with special constructions, `(not) containing` and `(not) within`.
  - Tokens can be named (`1:[]`) and their properties can be compared:
    `1:[pos="A.*"] [lemma="and"] 2:[] &`
    `1.lemma=2.lemma` returns constructions like *more and more*
- We add namespaces to properties and segment names: `conll:WORD`, `nif:Sentence`.
- List of namespaces and optional declaration of possible properties are configured for a given corpus.
- This allows handling multiple tagsets or multiple corpora.

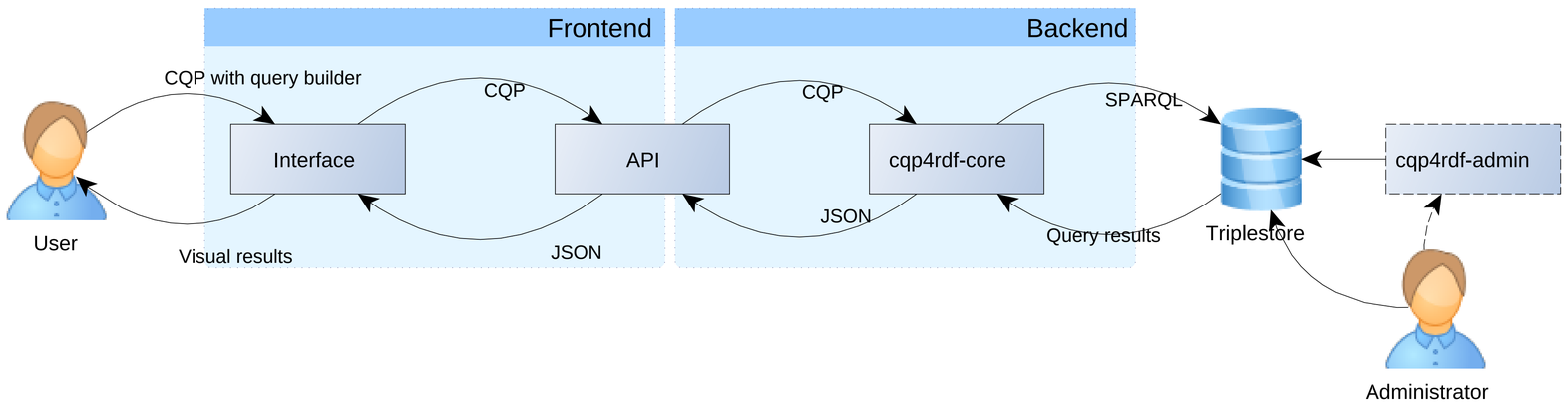
Examples

- A noun followed by a verb with 0 to 2 words in between:
  `[conll:UPOS="NOUN"] []{,2} [conll:UPOS="VERB"]`
- Pronouns with sequences of forms *to have*, *to be* or *to do*:
  `[conll:UPOS="PRON"] [conll:LEMMA="(have|be|do)"]{2,}`

3. `cqp4rdf` architecture

`cqp4rdf` is designed to have modular architecture and consists of

- Frontend: interface where user interacts with corpora,
- Backend: query conversion, getting and handling query results,
- Administrative part: adding and configuring corpora.



- Decoupling the frontend gives the possibility to use it with better developed corpus manager interfaces.
- Operations specific to RDF representations of corpora are localised and are used only before querying the triplestore → making it easier for adapting to different representations.
- In the current implementation, operations that modify data, e.g. linking or harmonising tagsets, are external to `cqp4rdf`.

4. Adding and configuring data

- One instance of `cqp4rdf` supports multiple corpora. Each has its section in the main configuration file, `config.yaml`.
- Global settings should include a pointer to a SPARQL endpoint of a triplestore with corpora.
- Adding a corpus is simple:
  - Insert RDF into a triplestore indicated in the config file,
  - Add a section describing a corpus into a configuration file. Necessary settings are the name, IRI with the corpus graph, and the list of prefixes.
- Additionally, it is possible to describe the data types and possible values for token properties, e.g. hide some fields or set a list of possible values for grammatical tags.

```yaml
ud-en:
  # name of the corpus
  name: Universal Dependencies English (test)
  iri: http://acoli.cs.uni-frankfurt.de/corpora/ud-en
  # all the prefixes which are defined for the SPARQL query
  prefixes:
    conll: http://ufal.mff.cuni.cz/conll2009-st/task-description.html#
    rdf: http://www.w3.org/1999/02/22-rdf-syntax-ns#
    terms: http://purl.org/acoli/open-ie/
    nif: http://persistence.uni-leipzig.org/nlp2rdf/ontologies/nif-core#
```

Fig. 2: A minimal configuration for a corpus

```yaml
UPOSTAG:
  name: UPOSTAG
  query: conll:UPOSTAG
  disabled: false
  type: list
  multivalued: false
  values:
    - "ADJ"
    - "ADV"
```

Fig. 3: Detailed configuration for a POS field

5. Current implementation

- A demo installation consists of a minimalistic frontend with a part of English Universal Dependencies corpus.
- Users can type a query and get results in a KWIC format, familiar for corpus linguists.
- Clicking on a token in the results, users can see all the properties of this token.
- The interface contains some example queries to start with.
- **Try it out at `https://purl.org/liodi/cqp4rdf/ud`**, learn more at `https://purl.org/liodi/cqp4rdf`

6. Future directions

Performance improvement

- In the current implementation, SPARQL queries are slow. → Benchmarking and optimising are needed.
- We could benefit from indexing to speed up common queries.
- Usually, storage and search is highly optimised for large corpora.
- Still, even for non-RDF corpus managers complex queries take time to execute.
- `cqp4rdf` works well for small corpora of less-resourced languages.
- Further experiments will show the range of its applicability

Managing corpora

- Adding and managing corpora via a dedicated interface would increase usability.
- Using CoNLL-RDF, we can import tab-separated corpus files (CoNLL format).
- Some data modification can be handled via SPARQL updates, they can be applied also using CoNLL-RDF.
- Providing a convenient way to apply predefined or custom updates will allow handling more advanced queries with less computational effort (i.e. adding multi-layered annotations for segments like sentences or named entities).

`cqp4rdf` in the wild

- To fully understand what is missing, we need use cases and corpus research done with `cqp4rdf`.
- To make this possible, one way would be to adapt existing corpus manager frontends
- Meanwhile, we continue our tests with different tagsets and languages:
  - Eastern Armenian National Corpus,
  - Corpora of less-resourced languages collected by field linguists,
  - Integration in Cuneiform Digital Library Initiative platform as a part of Google Summer of Code 2019.

:acoli dc:isPartOf <http://uni-frankfurt.de>.
[yeg] LiODi Linked Open Dictionaries
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