Automated standard compliance testing and visualization for the QLever SPARQL engine

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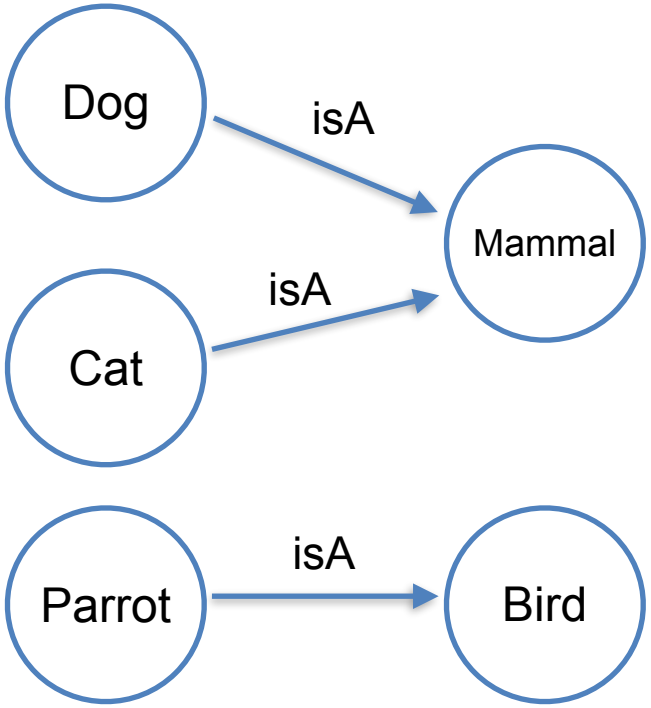
Problem - Background

- **R**esource **D**escription **F**ramework (**RDF**)
- Designed by World Wide Web Consortium (W3C)
- Directed graph using triples
- subject, predicate, object

subject	predicate	object
Dog	isA	Mammal
Cat	isA	Mammal
Parrot	isA	Bird



Problem - Background

- **S**PARLQ **P**rotocol **a**nd **R**DF **Q**uery **L**anguage (**SPARQL**)
- Designed by the World Wide Web Consortium

subject	predicate	object
Dog	isA	Mammal
Cat	isA	Mammal
Parrot	isA	Bird

```
SELECT ?animal
WHERE {
    ?animal isA Bird .
}
```

?animal
Parrot

Problem - Background

- **QLever** SPARQL engine
- Process and execute query
- Aims to fully support SPARQL 1.1
- Test the **standard compliance** of QLever using standardized tests provided by the W3C

Problem - Background

- SPARQL 1.1 test suite
- Consists of 603 tests
    1. Query/Update Evaluation Tests
    2. Syntax Tests
    3. Format Tests
    4. Protocol Tests
    5. Service Description Tests

Problem - Background

Live demo

Problem - Definition

1. Automate test suite execution
2. Visualize test result
3. Compare two executions
4. Integrate into workflow

Retaining and improving QLever's standard compliance

Problem - Definition

Questions ?

Approach - Extracting tests

- Using QLever
- Tests specify action and result
- Stored in manifest file

```
:agg01 rdf:type mf:QueryEvaluationTest ;
    mf:name "COUNT 1";
        mf:feature sparql:count ;
    rdfs:comment    "Simple count" ;
    dawgt:approval dawgt:Approved ;
    dawgt:approvedBy <http://www.w3.org/2009/sparql/meeting/2012-01-31#resolution_3> ;
    mf:action
         [ qt:query  <agg01.rq> ;
           qt:data   <agg01.ttl> ] ;
    mf:result  <agg01.srx>
    .
```

Approach - Test execution

1. Index graph
2. Prepare and send the query
3. Evaluate response
    1. Check response status
    2. if successful: **compare result**
4. Generate a string, highlighting differences in the results

Approach - Test execution

```
:agg01 rdf:type mf:QueryEvaluationTest ;
    mf:name "COUNT 1";
        mf:feature sparql:count ;
    rdfs:comment    "Simple count" ;
    dawgt:approval dawgt:Approved ;
    dawgt:approvedBy <http://www.w3.org/2009/sparql/meeting/2012-01-31#resolution_3> ;
    mf:action
         [ qt:query  <agg01.rq> ;
           qt:data   <agg01.ttl> ] ;
    mf:result  <agg01.srx>
    .
```

Approach - Comparing results

- Result formats
  1. Turtle or RDF/XML
  2. SPARQL 1.1 Query Results XML Format
  3. SPARQL 1.1 Query Results CSV/TSV Format
  4. SPARQL 1.1 Query Results JSON Format

- Implement comparison

Approach - Comparing results

- Custom comparison

  Method for SPARQL 1.1 Query Results

  1. Iterate over the elements of one result
  2. Remove matching elements in both results
  3. If both results are empty the results are equivalent

Approach - Comparing results

- Custom comparison
- Matching elements:
  - Ignore order
  - Handle blank nodes
  - Consider QLever specifics

Results Test Suite Execution

Protocol tests

```
:query_post_form rdf:type mf:ProtocolTest ;
       mf:name    "query via URL-encoded POST" ;
       rdfs:comment """
#### Request

    POST /sparql/ HTTP/1.1
    Host: www.example
    User-agent: sparql-client/0.1
    Content-Type: application/x-www-url-form-urlencoded
    Content-Length: XXX

    query=ASK%20%7B%7D

#### Response

    2xx or 3xx response
    Content-Type: application/sparql-results+xml or application/sparql-results+json

    true
       """ ;
```

Approach - Highlighting

1. Build a string representation of the result
2. Highlight parts that don't have a match in the other result
    1. Construct an HTML element for a leftover part.
    2. Replace that part in the string representation with the HTML element

result1
 result2
result3

result1
result2
result3

Approach

Questions ?

Approach - Website

- HTML, CSS, JS
- No custom backend server
- Bootstrap

Approach - Workflow

- GitHub Action
  1. Build QLever
  2. Run tests
  3. Send results to the visualization website
  4. Fail Action if prev. passed tests now fail
  5. Link website comparing the run with the main branch

Approach - Highlighting

Questions ?

Results Test Suite Execution

- Using QLever 22.03.2024
- Executing 600 tests:
  - 282 Query Evaluation Tests
  - 3 Result Format Tests
  - 94 Update Evaluation Tests
  - 169 Syntax Tests
  - 52 Protocol Tests
- 23.83% successfully processed
- 69.33% fail
- 6.83% semi-successfull

Results Test Suite Execution

Category	Tests	Passed	Semi-Passed	Failed	Pass Rate
Query	301	97	39	165	32.22% / 45.18%
Update	157	21	0	136	13.38%
CSV/ TSVFormat	6	6	0	0	100 %
JSON Format	4	0	2	2	0 % / 50%
Protocol	34	13	0	21	38.24%

Results Test Suite Execution

Category	Tests	Passed	Semi-Passed	Failed	Pass Rate
Federated Extensions	10	0	0	10	0 %
Entailment Regimes	70	4	0	66	5.71%
Graphstore Protocol	18	2	0	16	11.11%

Results Test Suite Execution

- Using QLever 22.03.2024
- Of the 416 failed tests:
  - 174 Query Exceptions (ex. 18 ASK)
  - 72 Error in result
  - 94 Update not supported
  - 60 Index error

Results Test Suite Execution

Questions ?