Jena

http://openjena.org/

The Beginning ...

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Date: Mon, 28 Aug 2000 13:40:03 +0100
To: "RDF Interest (E-mail)" <www-rdf-interest@w3.org>

A few weeks ago I posted some suggestions for an improved java RDF API.
I've placed an implementation of these ideas at
http://www-uk.hpl.hp.com/people/bwm/rdf/jena/index.htm
<http://www-uk.hpl.hp.com/people/bwm/rdf/jena/index.htm> .

The code supports in memory models. David Megginson's RDFFilter is hooked in so it can parse RDF serializations. I suggest you use the version of RDFFilter supplied in the distribution as it has some minor bug fixes. Its alpha code - it gets through the regression tests and runs the samples but hasn't had much use other than that. An SQL implementation may follow.

I think better tools will help encourage the adoption of RDF. I'm looking on this as an experiment to see whether this API brings any benefits. So I'd like some feedback.

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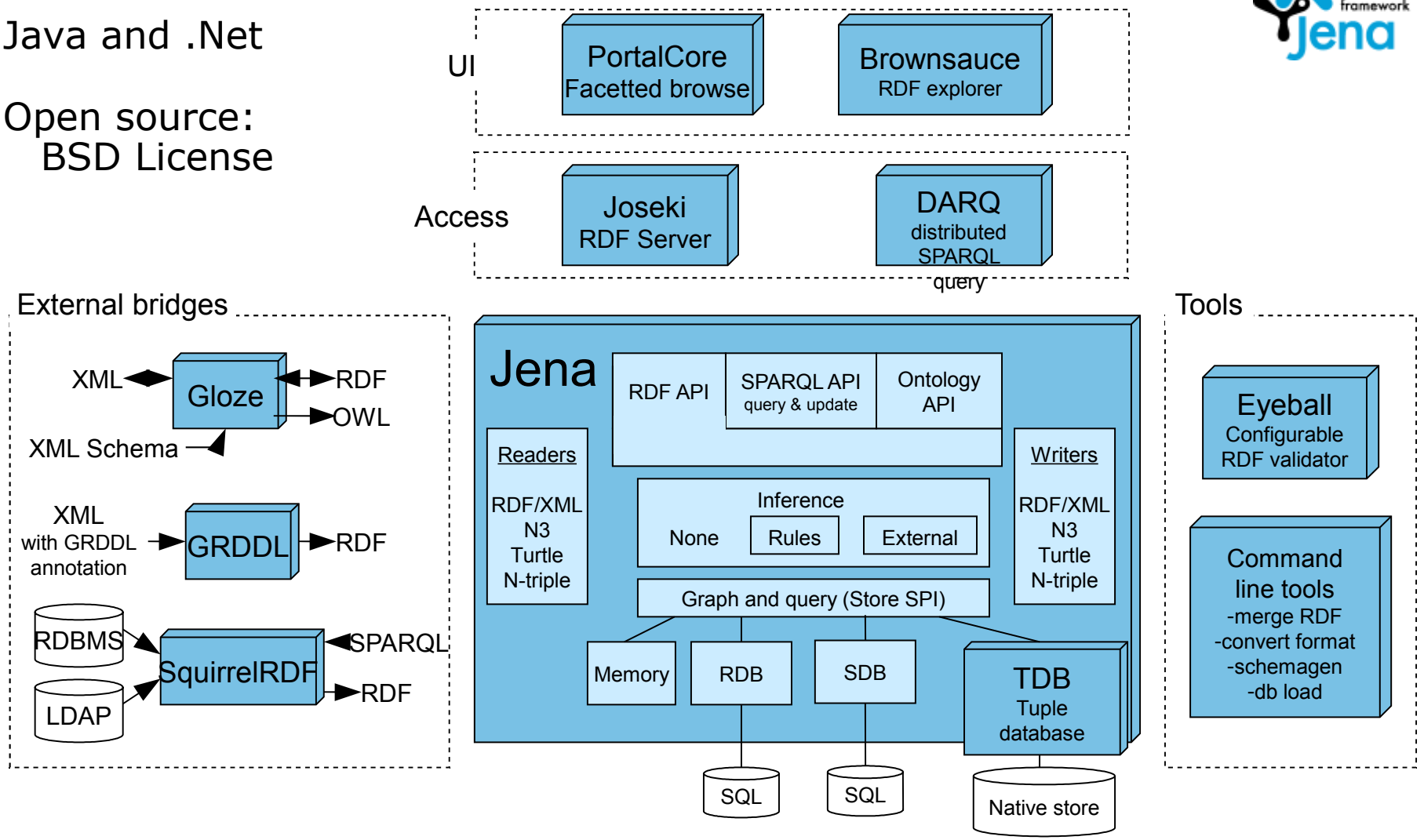
HPLabs

http://lists.w3.org/Archives/Public/www-rdf-interest/2000Aug/0128.html

Jena

Java and .Net

Open source:
BSD License



SPARQL 1.1

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- Complete query
  - Property paths
  - Aggregatrion, groups, subquery
- Service description
- Federated Query
- Update
  - HTTP update
    - Coarse-grained graph level
  - SPARQL Update Language
    - Fine-grained triple level manipulation
- Entailment

GROUP BY and Aggregation

```
SELECT (COUNT(*) AS ?C) { ?s ?p ?o }
```

```
SELECT ?s (COUNT(*) AS ?C)
{ ?s ?p ?o }
GROUP BY ?s
```

```
PREFIX : <http://people.example/>
PREFIX : <http://people.example/>
SELECT ?y ?minName
WHERE {
  :alice :knows ?y .
  {
    SELECT ?y (MIN(?name) AS ?minName)
    WHERE {
      ?y :name ?name .
    } GROUP BY ?y
  }
}
```

Property Paths

```
ex:me foaf:knows/foaf:name ?name .
```

```
?x rdf:type/rdfs:subClassOf* :SomeClass .
```

```
:aList rdf:next*/rdf:first ?member .
```

Negation

```
PREFIX  foaf:  <http://xmlns.com/foaf/0.1/>
PREFIX  rdf:    <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

# People with no declared name
SELECT *
{
  ?x rdf:type foaf:Person .
  FILTER NOT EXISTS {?x foaf:name ?name}
}
```

Negation

```
PREFIX  foaf:  <http://xmlns.com/foaf/0.1/>
PREFIX  rdf:    <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

# People with no declared name
SELECT *
{
  ?x rdf:type foaf:Person .
  MINUS {?x foaf:name ?name}
}
```

Federated Query

```
PREFIX  iuphar:     <http://iuphar.example/ns#>
PREFIX  entrez:     <http://entrez.example/ns#>
PREFIX  void:       <http://rdfs.org/ns/void#>
PREFIX  dcterms:    <http://purl.org/dc/terms/>

SELECT ?service ?id ?iuphar
WHERE {
  # Find the service with the expertise.
  [] dcterms:subject ?gene ;
     void:sparqlEndpoint ?service
  FILTER (?gene IN (entrez:h2550, entrez:h9568) )

  # Query that service for species and iuphar.
  SERVICE ?service {
    ?receptor  iuphar:species    ?species .
    ?species   iuphar:name       ?iuphar .
    ?species   entrez:id         ?id .
  }
}
```

Update Language

```
PREFIX  :       <http://example/>
PREFIX  foaf:   <http://xmlns.com/foaf/0.1/>
PREFIX  rdf:    <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

DELETE WHERE
{
   :person foaf:name ?x .
}

INSERT DATA
{
   :person foaf:name “Andy” .
}
```

HTTP Update

- GET, PUT, DELETE, POST graphs
- Naming:

```
http://host/store/g1

http://host/store?graph=http://example/g1
http://host/store?graph=http%3A%2F%2Fexample%2Fg1
```

TDB

Tuples Database

http://openjena.org/TDB/

SDB

SPARQL

```
PREFIX  dc:
<http://purl.org/dc/elements/1.1/>

SELECT *
 WHERE {
    ?x dc:title ?title ;
       dc:date ?date
}
```

SQL

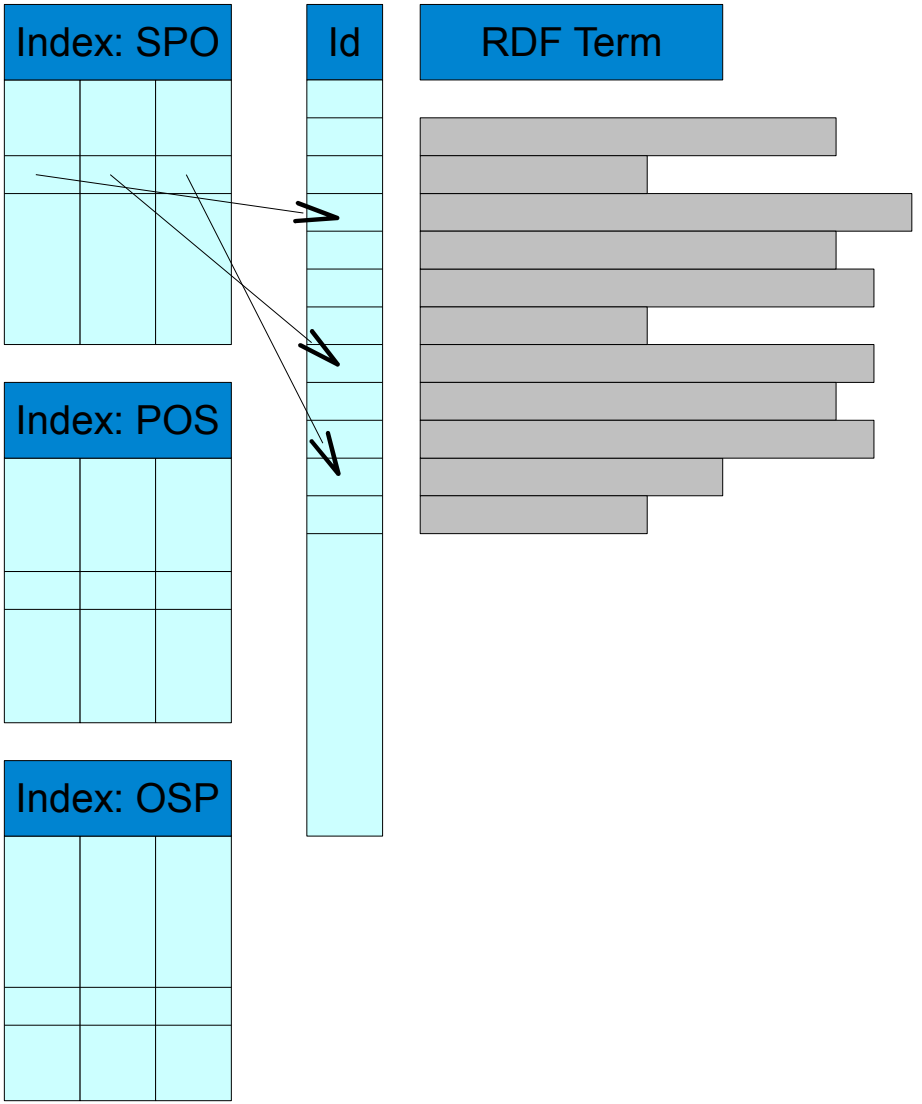
```
SELECT
  R_1.lex AS V_1_lex, R_1.datatype AS V_1_datatype,
  R_1.lang AS V_1_lang, R_1.type AS V_1_type,
  R_2.lex AS V_2_lex, R_2.datatype AS V_2_datatype,
  R_2.lang AS V_2_lang, R_2.type AS V_2_type,
  R_3.lex AS V_3_lex, R_3.datatype AS V_3_datatype,
  R_3.lang AS V_3_lang, R_3.type AS V_3_type
FROM
    Triples AS T_1
  INNER JOIN
    Triples AS T_2
  ON ( T_1.p = -5696047020500897841
   AND T_2.p = -4503196271826130170
   AND T_1.s = T_2.s
   )
  LEFT OUTER JOIN
    Nodes AS R_1
  ON ( T_1.s = R_1.hash )
  LEFT OUTER JOIN
    Nodes AS R_2
  ON ( T_1.o = R_2.hash )
  LEFT OUTER JOIN
    Nodes AS R_3
  ON ( T_2.o = R_3.hash )
```

TDB

- Lessons of the past …
  - SQL databases limited for RDF-style workloads
    - RDF workload Complete indexes; few, very large tables
  - SQL access costs (non-embedded databases) too high
  - SQL transactions can not be used for loading
  - ⇒ Modify the database internally or replace
- TDB
  - UI workloads
  - Non-transactional
  - 64 bit
  - Exploit modern operating system features

TDB

- 3 Index Design for triples
- RDF Terms ids allocated by sequence
  - Inline some xsd datatypes: integers, decimals, dates, datetimes
  - Never loose precision
- B+Tree
  - 100 way
  - Optimized range scans
  - Memory mapped I/O
- Cost-based, rule-based optimizer



32 bit vs 64 bit

- 64 bit: memory mapped files for B+Tree indexes
  - OS in control of paging
  - Segments of 8Mbytes
  - ==> the process size can look like many times the heap size.
- 32 bit: in-JVM caching of index blocks
  - Memory mapped files: JVM limitation of about 1.2Gbytes
  - LRU cache

TDB Bulk loader

- Efficient loading into empty databases
- Uses knowledge of index structure
  - Better use of RAM
  - Speeds: from 50K triples/s, slowing to 10K as total data grows

TDB Optimizer

- High level optimizations: algebra transformations
- Low level optimizations
  - Best order for a BGP
  - Rule based

```
(prefix ((xsd: <http://www.w3.org/2001/XMLSchema#>))
  (stats
    (meta
      (timestamp "2010-06-20T16:35:37.864+01:00"^^xsd:dateTime)
      (run@ "2010/06/20 16:35:37 BST")
      (count 10000))
    (<http://www.w3.org/1999/02/22-rdf-syntax-ns#type> 2101)
    (<http://purl.org/dc/elements/1.1/creator> 1106)
    (<http://musicbrainz.org/mm/mq-1.1#status> 63)
    (<http://musicbrainz.org/mm/mm-2.1#artistType> 124)
    (<http://purl.org/dc/elements/1.1/comment> 12)
    (<http://musicbrainz.org/mm/mm-2.1#trackList> 62)
    (<http://musicbrainz.org/mm/mm-2.1#trmidList> 682)
    (<http://purl.org/dc/elements/1.1/title> 1454)
    (<http://musicbrainz.org/mm/mm-2.1#endDate> 15)
    (<http://musicbrainz.org/mm/mm-2.1#beginDate> 76)
    (<http://musicbrainz.org/mm/mm-2.1#duration> 1009)
    (<http://musicbrainz.org/mm/mm-2.1#sortName> 348)
    (other 0)))
```

RDF Datasets

- A dataset is one un-named graph and zero or more named graphs (defined by SPARQL)
- TDB support RDF datasets
- Dynamic union
  - Default graph as union of all named graphs
  - `<urn:x-arq:UnionGraph>` the union of all named graphs
  - `<urn:x-arq:DefaultGraph>` is the concrete default graph
  - In SPARQL and named graph API

Variations

- TDB-BDB : http://github.com/afs/TDB-BDB
- TDB using Oracle Berkeley DB Java Edition
  - Swaps native B+Tree for BDB indexes
  - Uses BDB storage for RDF terms
  - Higher concurrency possible
  - Enables transactions
  - Contributions welcome!

RIOT

- New high performance parsers for N-Triples, N-Quads, Turtle andTriG
  - Parsers do higher level checking of URIs and literals
  - Warn or skip on bad RDF terms

Bad literals

```
"abc"^^xsd:integer
"1,000"^^xsd:integer
"Tue, 15 Jun 2010"^^xsd:date
"2010-02-30"^^xsd:date
"   123"^^xsd:int
```

Bad IRIs (or at least not recommended)

```
<http://example/foo bar>
<http://EXAMPLE.org/>
<http://example.org:80/
<http://example.org/abc[]def>
```