RDF Graph Applications: Rapid Development and Deployment in Oracle Cloud

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RDF Graphs in Oracle Database
Key Features

- Scalable RDF Graph database
  - Scales to billions of nodes and edges
- Full standards support
  - RDF, OWL, SPARQL
- Integrated with Property Graphs

- Enterprise capabilities – built on Oracle infrastructure
  - Manageability, fine-grained security, high availability, integration, and more
RDF Knowledge Graph Architecture

- Protégé Plugin
- Fuseki Endpoint
- Cytoscape Plugin
- SQL Developer RDF Support
- Enterprise Manager and Other DB Tools

Support for Apache Jena (Java API)

SQL and PL/SQL API

- RDF Bulk Loader
- Forward-chaining OWL Reasoner
- SPARQL-to-SQL Query Translator
- SPARQL Update Processor

RDF Data
Oracle SQL Developer RDF Support
RDF Graphs in Oracle Cloud
RDF Graphs and Database Cloud Services

- Oracle Database Cloud Service
- Autonomous Database
  - Autonomous Database - Dedicated
  - Autonomous Database – Shared

Roadmap
Preview:
RDF Graph Cloud Features

Roadmap
Preview: RDF Graph in Oracle Cloud

1. Planned for next release of Graph Server and Client
   - RDF Graph REST Server
     - SPARQL endpoint developed by Oracle (replaces Fuseki + Jena adapter)
   - Query UI

   - OCI Marketplace image for Jena Adapter
     - Point and click to download, install, deploy
RDF Graph REST API and Query UI
RDF REST and RDF Client application

- Motivation
  - Oracle RDF support has been available for many years
  - Features:
    - PLSQL API to manage Oracle RDF metadata
    - SQLDeveloper RDF plugin
    - Apache Jena adapter Java API
    - Apache Jena Fuseki with Oracle adapter is the application used to access Oracle RDF on the web
      - Limited to SPARQL queries and updates (no Oracle RDF metadata management)

- Lack of our own web solution for deployment on cloud or on-premises
Preview: RDF Server and Client Architecture

Oracle RDF server/client

RDF Server

WebLogic or J2EE Container

REST services

Oracle Database

External SPARQL endpoints dbpedia, Jena, Fuseki, ...
Oracle RDF Rest API – Server generic services

Base URL: /orardf/api/v1

**datasources**  RDF datasources

- **GET**  /datasources  Datasources information
- **GET**  /datasources/{name}  Registered datasource in server

**configurations**  Server configuration contents

- **GET**  /configurations/datasources  Stored datasource contents
- **GET**  /configurations/datasources/{name}  Stored datasource contents
- **GET**  /configurations/proxy  Stored proxy
- **GET**  /configurations/logging  Stored log settings
Oracle RDF Rest API – Oracle RDF datasources

**networks** Oracle RDF networks

```
GET /networks  Semantic networks
```

**models** Oracle RDF models

```
GET /models  RDF models
GET /models/{model}  RDF model
```

**rulebases** Oracle RDF rulebases

```
GET /rulebases  RDF rulebases
GET /rulebases/{rulebase}  RDF rulebase
```
Oracle RDF Rest API – SPARQL services – for all RDF datasources

Based on dataset definition payload parameter. Oracle example:
datasetDef = {"metadata" : {"networkOwner" : "RDFUSER", "networkName" : "LOCALNET", "models" : ["UNIV_BENCH"]}}

<table>
<thead>
<tr>
<th>Method</th>
<th>Endpoint</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>/datasets/triples</td>
<td>RDF triples</td>
</tr>
<tr>
<td>GET</td>
<td>/datasets/quads</td>
<td>RDF quads</td>
</tr>
<tr>
<td>GET</td>
<td>/datasets/query</td>
<td>Query RDF data</td>
</tr>
<tr>
<td>GET</td>
<td>/datasets/predicates</td>
<td>RDF distinct predicates</td>
</tr>
<tr>
<td>PUT</td>
<td>/datasets/update</td>
<td>Updates an existing dataset</td>
</tr>
</tbody>
</table>
Oracle RDF Graph Query UI

- Use of Oracle RDF REST services to communicate with back end server

- Access to Oracle RDF data sources and external (endpoint Url's) RDF data sources

- Manage Oracle RDF objects (create, edit, delete)

- Support to SPARQL query and to SPARQL update of RDF data

- Graph view of query results

- Use of Oracle JET for user interface
# Oracle RDF Graph Query UI

## Data sources

<table>
<thead>
<tr>
<th>NAME</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>db18cct</td>
<td>DATABASE</td>
<td>18c database</td>
</tr>
<tr>
<td>rdfuser12c</td>
<td>DATABASE</td>
<td>12c database</td>
</tr>
<tr>
<td>19cjdbc</td>
<td>DATABASE</td>
<td>test jdbc url</td>
</tr>
<tr>
<td>rdfuser193c</td>
<td>DATABASE</td>
<td>19.3 Oracle database on test machine</td>
</tr>
<tr>
<td>dbpedia</td>
<td>ENDPOINT</td>
<td>Dbpedia RDF data</td>
</tr>
</tbody>
</table>

---

**Create data source**

- Container
- Jdbc URL
- Endpoint

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Future Plans: Integrate with GraphViz and other tools

- Rest request to retrieve graph from a SPARQL construct query (@Path("v1/graphvis"))

```java
@GET
@Produces(MediaType.APPLICATION_JSON)
@Consumes(MediaType.TEXT_PLAIN)
@Path("construct")
public Response executeConstructQuery(@QueryParam("datasource") String datasource,
    @QueryParam("query") String query,
    @QueryParam("datasetDef") String datasetDefinition,
    @QueryParam("graphFormat") String graphFormat) {
```

The response for 'graphvis' format:

```json
{"graph":"{"idType":"number","vertices":{"_id":"11","p":
{"n":"name","v":"http://www.rdfabout.com/rdf/schema/usbill/sponsor","s":false},
{n":"type","v":"URI","s":false}
},"l":[]},
{0:"anonymous"},
{"_id":"12","p":
"n":"name","v":"http://www.rdfabout.com/rdf/schema/usgovt/fipsCountyCode","s":false,

{n":"type","v":"URI","s":false}
},"l":[]},
```

...
RDF Jena Adapter in
OCI Marketplace
RDF Jena adapter in Oracle OCI Marketplace

- Publish Oracle RDF Jena adapter implementation in OCI Marketplace
  - https://cloudmarketplace.oracle.com/marketplace/oci

- OCI Marketplace listing types:
  - custom image
  - resource manager (stacks)

- Oracle RDF listings:
  - A Linux custom image listing with the resources needed for Oracle RDF Jena adapter
    - Weblogic installer, JDK 1.8, Oracle Jena Adapter kit
  - A resource manager listing (stack)
    - WebLogic installed, and an Apache Jena Fuseki deployed with support to Oracle RDF datasets
Oracle RDF Graph Adapter for Apache Jena

Java based interface to Oracle Database RDF Graph

The RDF graph feature in Oracle Database provides native support for RDF, OWL and SPARQL W3C standards for representing and querying knowledge graphs and semantic data. This app enables users to create a SPARQL end point using open source Apache Jena / Fuseki, for querying RDF graphs in a Oracle Database Cloud Service.

Analytics, Database Management, Packaged Application

Type
Stack
Version
19.1.0 - default
Compartment
rdf_dev
oraclecloud/rdf_dev

Software Price per OCPU
BYOL
(Bring Your Own License)

There are additional fees for the infrastructure usage.

I have reviewed and accept the Oracle Standard Terms and Restrictions.

Launch Stack
Create Stack – stack information
Create Stack – Configure variables step

Create Stack

RDF Jena Adapter Compute Instance

RESOURCE NAME PREFIX

prefix: instance

The prefix is used for creating compute instances. This prefix will be used for creating compute instances in the stack.

RDF Jena Adapter WEBSLOGIC SERVER COMPARTMENT

RDF:Jena

The compartment in which to create the RDF Jena Adapter compute instance.

WEBLOGIC SERVER AVAILABILITY DOMAIN

TTS-US-ASHBURN-AD-2

The availability domain in which to create the WebLogic Server compute instance.

WEBLOGIC SERVER SHAPE

VM-Standard2.1

The shape for the Oracle WebLogic Server compute instance.

يجيد PUBLICATION KEY

YgkhiYXyEz5WbJuAEEgMjR+Pzt29+u26cXy/cf79Hw1tVAtsQSxmg

Use the corresponding public key to create the RDF Jena Adapter WebLogic Server compute instance.

Create Stack

Stack Information

company name

ocl

WebLogic server name

......

Generate password for administrator user

Create RDF dataset for Jena Fuseki

NAME

JenaFuseki

UNIT: [HEAD]

Inference server (used by Jena Fuseki)

USER: [JENAFUSEKI]

jena fuseki user account

PASSWORD: [jena Fuseki password]

JENA_INFERENCE: [true]

Inference enabled for Jena Fuseki

CREATEทอด dataset for Jena Fuseki

Datasource Definition

WEBLOGIC DATASOURCE NAME

JFITS

The name of the WebLogicDatasource, the name will be used for Jena inference.

DATABASE HOST

your host.com

The hostname or IP address where the database is hosted.

DATABASE PORT

1521

The port number for the database.

DATABASE SERVICE NAME

orcl125.us.oracle.com

The name of the database service to which the connection will be made.

DATABASE USER

root

The username to connect with.

DATABASE PASSWORD

password

The password to connect with.
Applications running on OCI instance

- Weblogic console: https://machine_ip:7002/console

- Apache Jena Fuseki: https://machine_ip:8001/fuseki
Summary

- RDF Graph query and data management
  - Extreme scalability
  - Feature-rich
  - Standards compliant
  - Fully integrated

- RDF Cloud plans: RDF Graph REST API and Query UI
Thank You

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