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1.0 History

(courtesy of https://github.com/semsol/arc2/wiki)

ARC started in 2004 as a lightweight RDF system for parsing and serializing RDF/XML files. It later evolved into a more complete framework with storage and query functionality. By 2011, ARC2 had become one of the most-installed RDF libraries. Nevertheless, active code development had to be discontinued due to lack of funds and the inability to efficiently implement the ever-growing stack of RDF specifications. The source continues to be available to the community through github.
2.0 Quick Links

2.1 ARC2 RDF Store manual links

6. HTTP Reader: [https://github.com/semsol/arc2/wiki/HTTP-Reader](https://github.com/semsol/arc2/wiki/HTTP-Reader)
3.0 Getting Started

3.1 Installation of ARC2

3.1.1 Requirements
- For this demonstration, WAMPserver was used, as available at: http://www.wampserver.com/en/
- Basic requirements:
  a. A web server with PHP5 or PHP4.3 or higher, http://www.php.net
  b. MySQL 5.0 or higher, http://www.mysql.com
  c. Also works in LAMP environment

3.1.2 Installation of PHP Libraries
1) In a web browser, go to https://github.com/tuukka/arc2-starter-pack
2) Download tuukka-arc2-starter-pack-f9865d2.zip from https://github.com/tuukka/arc2-starter-pack/zipball/master
3) Extract tuukka-arc2-starter-pack-f9865d2 directory to local machine
   Result: <local directory>/ tuukka-arc2-starter-pack-f9865d2.
4) Navigate to the local PHP www root directory, <PHP server>/www
   Examples:
   i) C:\Program Files\wamp\www
   ii) C:\wamp\www
5) In www directory, create arc2-starter-pack subdirectory
   Result: www/arc2-starter-pack.
6) Copy contents from tuukka-arc2-starter-pack-f9865d2 directory into arc2-starter-pack directory
7) The following directory and files should be in the arc2-starter-pack directory
   • admin/ <dir>
   • cli.php
   • config.php
   • endpoint.php
   • index.php
   • README
8) In arc2-starter-pack php directory, create arc subdirectory
   Result: arc2-starter-pack/arc
9) In a web browser, go to https://github.com/semsol/arc2/

10) Download semsol-arc2-495d10b.zip from https://github.com/semsol/arc2/zipball/master

11) Extract semsol-arc2-495d10b directory to local machine
   *Result: <local directory>/ semsol-arc2-495d10b.*
   *Examples:
   i) C:\Program Files\wamp\www\arc2-starter-pack\arc
   ii) C:\wamp\www\arc2-starter-pack\arc

12) Copy contents from semsol-arc2-495d10b directory into www/arc2-starter-pack/arc PHP directory
   a) The following directories and files should be in the arc2-starter-pack directory
      • extractors/ <dir>
      • parsers/ <dir>
      • serializers/ <dir>
      • parqlscript/ <dir>
      • store/ <dir>
      • .gitignore
      • ARC2.php
      • ARC2_Class.php
      • ARC2_getFormat.php
      • ARC2_getPreferredFormat.php
      • ARC2_Reader.php
      • ARC2_Resource.php
      • ARC2_TestHandler.php

3.1.3 Installation of MySQL Schema
1) In local MySQL server, create database name arc2test
   create schema arc2test;

2) In local MySQL server, create user with all permissions on arc2test schema
   grant all on arc2test.* to 'arc2test_user'@'%' identified by 'RandomPassword';

3) Open config.php file located in the PHP subdirectory arc2-starter-pack and modify credentials for root user local mysql server

Sample Directories:
   i) C:\Program Files\wamp\www\arc2-starter-pack
   ii) C:\wamp\www\arc2-starter-pack

File Modification Example:
config.php
// SQL database configuration for storing the postings:
$arc_config = array(
  /* MySQL database settings */
  'db_host' => 'localhost',
  'db_user' => 'arc2test_user',
  'db_pwd' => 'RandomPassword',
  'db_name' => 'arc2test',
)

4) To create the tables for the RDF Store, in a web browser, go to http://localhost:<PHP server port number>/arc2-starter-pack/

Examples:
  i)   http://localhost:8090/arc2-starter-pack/
  ii)  http://localhost:8080/arc2-starter-pack/

Within the index.php file on the default install, the following lines of code will create the RDF Store Tables:

```
$store = ARC2::getStore($config);
if (!$store->isSetUp()) {
    $store->setUp();
}
```

3.1.4 Configure the included SPARQL endpoint

1) Edit endpoint.php to point to local sandbox

Sample Directories:
   iii) C:\Program Files\wamp\www\arc2-starter-pack
   iv)  C:\wamp\www\arc2-starter-pack

$config = array(
  /* db */
  'db_host' => 'localhost',
  'db_name' => 'arc2test',
  'db_user' => 'arc2test_user',
  'db_pwd' => 'RandomPassword',
  /* store name */
  'store_name' => 'sandbox',

2) To access the SPARQL endpoint, in a web browser, go to http://localhost:<PHP server port number>/arc2-starter-pack/endpoint.php
Examples:
   i)  http://localhost:8090/arc2-starter-pack/endpoint.php
4.0 Using the ARC2 libraries

4.1 Command line import functionality

4.1.1 Loading OWL/RDF Data

In the following instructions, we will be using Periodic Table OWL/RDF data from created by Michael Cook, [http://www.daml.org/2003/01/periodictable/PeriodicTable.owl](http://www.daml.org/2003/01/periodictable/PeriodicTable.owl).

There are two ways to load OWL/RDF data into RDF local store (MySQL database)
- Command Line
- PHP Application Load

**Linux**
- cd arc2-starter-pack/
- chmod +x cli.php
- ./cli.php "LOAD <http://chatlogs.planetrdf.com/swig/2009-07-26>"
- ./cli.php "LOAD <file:///home/user/local_file.rdf>"
- ./cli.php "LOAD <file://$PWD/file_in_current_dir.ttl>"
- ./cli.php "DELETE FROM <http://chatlogs.planetrdf.com/swig/2009-07-26>"

**Windows**
- cd arc2-starter-pack/
- <PHP Installation>/php.exe cli.php "LOAD <file:///home/user/local_file.rdf>"
- <PHP Installation>/php.exe cli.php "LOAD <file://$PWD/file_in_current_dir.ttl>"

**Sample Windows Output:**
*Note: these commands are executed from the Windows COMMAND LINE*
*Note: Make sure that your php executable path is in your systems PATH variable*

cd C:\Program Files\wamp\www\arc2-starter-pack

**Sample input**
php.exe cli.php "LOAD <http://xmlns.com/foaf/spec/index.rdf>"  
Loaded 634 triples.
Sample query: Select from Local Data Store

Sample output
C:\Program Files\wamp\www\arc2-starter-pack>php cli.php "LOAD <http://xmlns.com/foaf/spec/index.rdf>
Loaded 634 triples.

C:\Program Files\wamp\www\arc2-starter-pack>php cli.php "SELECT DISTINCT ?property WHERE { ?subject ?property ?object . }
property
http://www.w3.org/1999/02/22-rdf-syntax-ns#type
http://purl.org/dc/elements/1.1/description
http://purl.org/dc/elements/1.1/title
http://www.w3.org/2003/06/sw-vocab-status/ns#term_status
http://www.w3.org/2000/01/rdf-schema#label
http://www.w3.org/2000/01/rdf-schema#comment
http://www.w3.org/2000/01/rdf-schema#isDefinedBy
http://www.w3.org/2000/01/rdf-schema#subClassOf
http://www.w3.org/2002/07/owl#disjointWith
http://www.w3.org/2002/07/owl#equivalentClass
http://www.w3.org/2000/01/rdf-schema#domain
http://www.w3.org/2000/01/rdf-schema#range
http://www.w3.org/2000/01/rdf-schema#subPropertyOf
http://www.w3.org/2002/07/owl#inverseOf
http://www.w3.org/2002/07/owl#equivalentProperty

Sample query: Delete from Local Data Store
php cli.php "DELETE FROM <http://xmlns.com/foaf/spec/index.rdf>"

4.1.2 Loading Data via Command Line

1) In windows environment, add PHP bin to the %PATH% environment
C:/<PHP Server>/bin/php.exe

2) Navigate to the location of www/arc2-starter-pack directory

3) Run the following command (all on one line)
> php.exe cli.php "LOAD <http://
http://www.daml.org/2003/01/periodictable/PeriodicTable.owl>"

4) If PeriodicTable.owl was downloaded on to local machine, navigate to the directory containing
the data file an run the following command
> php.exe cli.php "LOAD <file://<location data is
stored>PeriodicTable.owl>"

• If successful, you will see the following output
  Loaded 1847 triples.
4.1.3 Loading Data via Application Code

1) Navigate to <PHP server>/www/arc2-starter-pack directory.
2) Create new php file called, sample.php.
3) In load.php, copy and paste the following lines of code

```php
include_once("path/to/arc/ARC2.php");

$config = array(
    /* db */
    'db_name' => 'my_db',
    'db_user' => 'user',
    'db_pwd' => 'secret',
    /* store */
    'store_name' => 'arc_tests',
    /* stop after 100 errors */
    'max_errors' => 100,
);
$store = ARC2::getStore($config);
if (!$store->isSetUp()) {
    $store->setUp(); /* create MySQL tables */
}

$store->query('LOAD <http://www.daml.org/2003/01/periodictable/PeriodicTable.owl>');</p>

```

4) Open web browser and go to http://localhost:<PHP server port number>/arc2-starter-pack/load.php
   a. Only run this page once or else the data will be inserted into the local RDF store multiple times.

4.2 Querying Against Local Data Using SPARQL

4.2.1 Query all triples in the Local RDF Store

1) Navigate to <PHP server>/www/arc2-starter-pack directory.
2) Create new php file called, local_query_triple.php.
3) Copy and paste the following lines of code in local_query_triple.php in to execute a SPARQL Query to list each subject, object, domain triple in RDF store.

```php
include_once("arc/ARC2.php");
include_once('config.php');

$store = ARC2::getStore($arc_config);
if (!$store->isSetUp()) {
    $store->setUp(); /* create MySQL tables */
}

$q = 'SELECT DISTINCT ?subject ?property ?object WHERE {
```
4) Open web browser and go to http://localhost:<PHP server port number>/arc2-starter-pack/local_query_triple.php

4.2.2 Querying Local Data Using SPARQL:


1) Navigate to <PHP server>/www/arc2-starter-pack directory.

2) Create new php file called, local_query_periodic.php.

3) Copy and paste the following lines of code in local_query_periodic.php.

```php
<?php
include_once("arc/ARC2.php");
include_once('config.php');

$store = ARC2::getStore($arc_config);
if (!$store->isSetUp()) {
    $store->setUp(); /* create MySQL tables */
}

$q = 'PREFIX table:' .
    '<http://www.daml.org/2003/01/periodictable/PeriodicTable#>
SELECT *
FROM <http://www.daml.org/2003/01/periodictable/PeriodicTable.owl>
WHERE

'};

$rows = $store->query($q, 'rows');
$r = "";
if ($rows = $store->query($q, 'rows')) {
    $r = '<table border=1>
        <th>Subject</th><th>Property</th><th>Object</th>
        
    </table>' .
    '<tr><td>'.$row['subject'] .
        '</td><td>'.$row['property'] .
        '</td><td>'.$row['object'] .
        '</td></tr>
    
}
$r .='</table>' .
else{
    $r = '<em>No data returned</em>';
}
echo $r;
?>
```
$rows = $store->query($q, 'rows');

$r = ''; if ($rows = $store->query($q, 'rows')) {
    $r = '<table border=1>
    <th>Name</th><th>Symbol</th><th>Number</th>
    </tr>
    foreach ($rows as $row) {
        $r .= '<tr><td>'.$row['name'] . '</td><td>'.$row['symbol'] . '</td><td>'.$row['number'] . '</td></tr>
    }
    $r .= '</table>'; } else{ $r = '<em>No data returned</em>'; }
}

echo $r;

4) Open web browser and go to http://localhost:<PHP server port number>/arc2-starter-pack/local_query_periodic.php

### 4.3 Accessing Data from a Remote Data Store

#### 4.3.1 Concept of a remote store

So one can load remote data into a local data store and run fast, local queries. But the problem remains that data changes. And keeping up the changes is the natural purview of the data owner, not an application developer.

ARC2 addresses this problem with the concept of the Remote Data Store. ARC2 allows the store initialization clause to address a remote data store instead of a local data store, and still access the data in the same exact fashion that one would for local data.

Documentation Link: https://github.com/semsol/arc2/wiki/Remote-Stores-and-Endpoints
Configuration format:

/* ARC2 static class inclusion */
include_once('path/to/arc/ARC2.php');

/* configuration */
$config = array(
    /* remote endpoint */
    'remote_store_endpoint' => 'http://example.com/sparql',
);

/* instantiation */
$store = ARC2::getRemoteStore($config);

4.3.2 Querying Remote Data Using SPARQL:

Example 1

Using the remote data store from the Linked Movie Database (linkedmdb.org), find actors who’ve worked with Kevin Bacon and the number of movies in which they’ve worked together.

1) Navigate to <PHP server>/www/arc2-starter-pack directory.

2) Create new php file called, remote_query_movies.php.

Copy and paste the following lines of code into the new file, remote_query_movies.php:

```php
<?php
include("config.php");

$remote_store_endpoint = 'http://data.linkedmdb.org/sparql';

/* configuration */
$config = array(
    /* remote endpoint (gene database)*/
    'remote_store_endpoint' => $remote_store_endpoint,
);

/* instantiation */
$store = ARC2::getRemoteStore($config);

$q =
SELECT DISTINCT (COUNT(?kb) AS ?movieCount) ?actorName WHERE {
    ?kb <http://data.linkedmdb.org/resource/movie/actor_name> "Kevin Bacon".
    ?movie <http://data.linkedmdb.org/resource/movie/actor> ?kb;
    FILTER (?kb != ?actor).
}GROUP BY ?actorName ORDER BY ?actorName
';
```
$rows = $store->query($q, 'rows');
$result = $store->query("");

print "<HTML>
";
print "<HEAD>
";
print "<TITLE>Actors who've been in a movie with Kevin Bacon</TITLE>
";
print "<link rel='stylesheet' type='text/css'
href='http://data.linkedmdb.org/snorql/style.css' />
"
;
print "</HEAD>
";
print "<BODY>
";
print "<h1>Actors who've been in a movie with Kevin Bacon</h1>
";
print "<p>
";
print "<TABLE BORDER=1 class='queryresults'>
";
print "<TR>
";
print "<TH>Movie Count</TH>
";
print "<TH>Actor</TH>
";
print "</TR>
";
$row_counter = 0;
if ($rows = $store->query($q, 'rows')) {
    foreach ($rows as $row) {
        print "<TR";
        if ($row_counter%2 == 0) {
            print "class='even'";
        } else {
            print "class='odd'";
        }
        print " >\n";
        print "<TD> " . $row['movieCount'] . " </TD>
" . $row['actorName'] . " <TD>
";
        print "</TR>
";
        $row_counter ++;
    }
} //end if --non-empty results
else {
    print "<TR>
";
    print "<TD>no data found</TD>
";
    print "</TR>
";
} //end else --empty results
print "</TABLE>
";
print "</p>
";
print "</BODY></HEAD>
";
?>
Example 2

Using the remote data store from the Gene Ontology Database (www.obofoundry.org), find cellular processes that are either integral to, or a refinement of, signal transduction.

1) Navigate to <PHP server >/www/arc2-starter-pack directory.

2) Create new php file called, remote_query_gene.php.

Copy and paste the following lines of code in remote_query_gene.php.

```php
<?php
include("config.php");

$remote_store_endpoint = 'http://data.linkedmdb.org/sparql';
/* configuration */
$config = array(
    /* remote endpoint (gene database)*/
    'remote_store_endpoint' => $remote_store_endpoint,
);
/* instantiation */
$store = ARC2::getRemoteStore($config);

$q = 'SELECT DISTINCT (COUNT(?kb) AS ?movieCount) ?actorName WHERE {
    ?kb <http://data.linkedmdb.org/resource/movie/actor_name> "Kevin Bacon".
    ?movie <http://data.linkedmdb.org/resource/movie/actor> ?kb;
    FILTER (?kb != ?actor).
}GROUP BY ?actorName ORDER BY ?actorName
';
$rows = $store->query($q, 'rows');
$result = $store->query(""");
print "<HTML>
";
print "<HEAD>
";
print "<TITLE>Actors who've been in a movie with Kevin Bacon</TITLE>
";
print "<link rel='stylesheet' type='text/css' href='http://data.linkedmdb.org/snorql/style.css' />
";
print "</HEAD>
";
print "<BODY>
";
print "<h1>Actors who've been in a movie with Kevin Bacon</h1>
";
print "<p>
";
print "<TABLE BORDER=1 class='queryresults'>
";
print "<TH>Movie Count</TH>
";
```
print "<TH>Actor</TH>
";
print "</TR>
";
$row_counter = 0;
if ($rows = $store->query($q, 'rows')) {
    foreach ($rows as $row) {
        print "<TR ";
        if ($row_counter%2 == 0) {
            print "class='even'";
        } else {
            print "class='odd'";
        }
        print " >\n";
        print "<TD> " . $row['movieCount'] . " </TD><TD> " . $row['actorName'] . "</TD>
";
        print "</TR>
";
        $row_counter ++;
    }
} //end if --non-empty results
else {
    print "<TR>
";
    print "<TD>no data found</TD>
";
    print "</TR>
";
} //end else --empty results
print "</TABLE>
";
print "</p>
";
print "</BODY></HEAD>
";
?>
5.0 References

Articles and Wikis:

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   http://groups.google.com/group/arc-dev
   http://data-gov.tw.rpi.edu/wiki/ARC2
   https://github.com/semsol/arc2/wiki/
   http://linkeddata.org/
   http://richard.cyganiak.de/2007/10/lod/
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   http://semantic-mediawiki.org/wiki/SPARQL_and_RDF_stores_for_SMW
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10. SPARQL Query Language for RDF, 2008. W3C.
    http://www.w3.org/TR/rdf-sparql-query/
    http://www.w3.org/wiki/SparqlEndpoints
    http://www.ted.com/talks/tim_berners_lee_on_the_next_web.html
Data Sites:

1. Linked Movie Database  
   http://www.linkedmdb.org/
2. The Open Biological and Biomedical Ontologies  
   http://www.obofoundry.org/  
3. UK Government datasets  
   http://data.gov.uk/data
4. U.S. Federal Executive Branch datasets  
   http://www.data.gov/catalog/raw
5. U.S. Office of Personnel Management  
   http://www.fedscope.opm.gov/