

Using JSON-LD in AllegroGraph – Python Example



The following is example #19 from our AllegroGraph Python Tutorial.

JSON-LD is described pretty well at <https://json-ld.org/> and the specification can be found at <https://json-ld.org/latest/json-ld/> .

The website <https://json-ld.org/playground/> is also useful.

There are many reasons for working with JSON-LD. The major search engines such as Google require ecommerce companies to mark up their websites with a systematic description of their products and more and more companies use it as an easy serialization format to share data.

The benefit for your organization is that you can now combine your documents with graphs, graph search and graph algorithms. Normally when you store documents in a document store you set up your documents in such a way that it is optimized for direct retrieval queries. Doing complex joins for multiple types of documents or even doing a shortest path through a mass of object (types) is however very complicated. Storing JSON-LD objects in AllegroGraph gives you all the benefits of a document store *and* you can semantically link objects together, do complex joins and even graph search.

A second benefit is that, as an application developer, you do not have to learn the entire semantic technology stack, especially the part where developers have to create individual triples or edges. You can work with the JSON data serialization format that application developers usually

prefer.

In the following you will first learn about JSON-LD as a syntax for semantic graphs. After that we will talk more about using JSON-LD with AllegroGraph as a document-graph-store.

Setup

You can use Python 2.6+ or Python 3.3+. There are small setup differences which are noted. You do need *agraph-python-101.0.1* or later.

Mimicking instructions in the Installation document, you should set up the virtualenv environment.

1. Create an environment named *jsonld*:

```
python3 -m venv jsonld
```

or

```
python2 -m virtualenv jsonld
```

2. Activate it:

Using the Bash shell:

```
source jsonld/bin/activate
```

Using the C shell:

```
source jsonld/bin/activate.csh
```

3. Install *agraph-python*:

```
pip install agraph-python
```

And start **python**:

```
python  
[various startup and copyright messages]  
>>>
```

We assume you have an AllegroGraph 6.5.0 server running. We call **ag_connect**. Modify the *host*, *port*, *user*, and *password* in your call to their correct values:

```
from franz.openrdf.connect import ag_connect  
with ag_connect('repo', host='localhost', port='10035',  
               user='test', password='xyzzzy') as conn:  
    print (conn.size())
```

If the script runs successfully a new repository named *repo* will be created.

JSON-LD setup

We next define some utility functions which are somewhat different from what we have used before in order to work better with JSON-LD. **createdb()** creates and opens a new repository and **opendb()** opens an existing repo (modify the values of *host*, *port*, *user*, and *password* arguments in the definitions if necessary). Both return repository connections which can be used to perform repository operations. **showtriples()** displays triples in a repository.

```
import os  
import json, requests, copy  
  
from    franz.openrdf.sail.allegrographserver    import  
AllegroGraphServer  
from franz.openrdf.connect import ag_connect  
from franz.openrdf.vocabulary.xmlschema import XMLSchema  
from franz.openrdf.rio.rdfformat import RDFFormat
```

```

# Functions to create/open a repo and return a
RepositoryConnection
# Modify the values of HOST, PORT, USER, and PASSWORD if
necessary

def createdb(name):
    return
    ag_connect(name,host="localhost",port=10035,user="test",passwo
rd="xyzy",create=True,clear=True)

def opendb(name):
    return
    ag_connect(name,host="localhost",port=10035,user="test",passwo
rd="xyzy",create=False)

def showtriples(limit=100):
    statements = conn.getStatements(limit=limit)
    with statements:
        for statement in statements:
            print(statement)

```

Finally we call our **createdb** function to create a repository and return a *RepositoryConnection* to it:

```
conn=createdb('jsonplay')
```

Some Examples of Using JSON-LD

In the following we try things out with some JSON-LD objects that are defined in json-ld playground: jsonld

The first object we will create is an *event dict*. Although it is a Python dict, it is also valid JSON notation. (But note that not all Python dictionaries are valid JSON. For example, JSON uses null where Python would use None and there is no magic to automatically handle that.) This object has one key called @context which specifies how to translate keys and values into predicates and objects. The following @context says that every time you see ical: it

should be replaced by `http://www.w3.org/2002/12/cal/ical#`, `xsd:` by `http://www.w3.org/2001/XMLSchema#`, and that if you see `ical:dtstart` as a key then the value should be treated as an `xsd:dateTime`.

```
event = {
  "@context": {
    "ical": "http://www.w3.org/2002/12/cal/ical#",
    "xsd": "http://www.w3.org/2001/XMLSchema#",
    "ical:dtstart": { "@type": "xsd:dateTime" }
  },
  "ical:summary": "Lady Gaga Concert",
  "ical:location": "New Orleans Arena, New Orleans, Louisiana, USA",
  "ical:dtstart": "2011-04-09T20:00:00Z"
}
```

Let us try it out (the subjects are blank nodes so you will see different values):

```
>>> conn.addData(event)
>>> showtriples()
(_:b197D2E01x1, <http://www.w3.org/2002/12/cal/ical#summary>,
"Lady Gaga Concert")
(_:b197D2E01x1, <http://www.w3.org/2002/12/cal/ical#location>,
"New Orleans Arena, New Orleans, Louisiana, USA")
(_:b197D2E01x1, <http://www.w3.org/2002/12/cal/ical#dtstart>,
"2011-04-09T20:00:00Z"^^<http://www.w3.org/2001/XMLSchema#date
Time>)
```

Adding an @id and @type to Objects

In the above we see that the JSON-LD was correctly translated into triples but there are two immediate problems: first each subject is a blank node, the use of which is problematic when linking across repositories; and second, the object does not have an RDF type. We solve these problems by adding an `@id` to provide an IRI as the subject and adding a `@type` for the object (those are at the lines just after

the *@context* definition):

```
>>> event = {
  "@context": {
    "ical": "http://www.w3.org/2002/12/cal/ical#",
    "xsd": "http://www.w3.org/2001/XMLSchema#",
    "ical:dtstart": { "@type": "xsd:dateTime" }
  },
  "@id": "ical:event-1",
  "@type": "ical:Event",
  "ical:summary": "Lady Gaga Concert",
  "ical:location": "New Orleans Arena, New Orleans,
Louisiana, USA",
  "ical:dtstart": "2011-04-09T20:00:00Z"
}
```

We also create a test function to test our JSON-LD objects. It is more powerful than needed right now (here we just need *conn, addData(event)* and *showTriples()* but **test** will be useful in most later examples. Note the *allow_external_references=True* argument to *addData()*. Again, not needed in this example but later examples use external contexts and so this argument is required for those.

```
def
test(object, json_ld_context=None, rdf_context=None, maxPrint=100
, conn=conn):
    conn.clear()
    conn.addData(object, allow_external_references=True)
    showtriples(limit=maxPrint)
```

```
>>> test(event)
(<http://www.w3.org/2002/12/cal/ical#event-1>,
<http://www.w3.org/2002/12/cal/ical#summary>, "Lady Gaga
Concert")
(<http://www.w3.org/2002/12/cal/ical#event-1>,
<http://www.w3.org/2002/12/cal/ical#location>, "New Orleans
Arena, New Orleans, Louisiana, USA")
(<http://www.w3.org/2002/12/cal/ical#event-1>,
<http://www.w3.org/2002/12/cal/ical#dtstart>,
```

```
"2011-04-09T20:00:00Z"^^<http://www.w3.org/2001/XMLSchema#date
Time>)
(<http://www.w3.org/2002/12/cal/ical#event-1>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://www.w3.org/2002/12/cal/ical#Event>)
```

Note in the above that we now have a proper subject and a type.

Referencing a External Context Via a URL

The next object we add to AllegroGraph is a person object. This time the @context is not specified as a JSON object but as a link to a context that is stored at <http://schema.org/>. Also in the definition of the function test above we had this parameter in `addData:allow_external_references=True`. Requiring that argument explicitly is a security feature. One should use external references only that context at that URL is trusted (as it is in this case).

```
person = {
  "@context": "http://schema.org/",
  "@type": "Person",
  "@id": "foaf:person-1",
  "name": "Jane Doe",
  "jobTitle": "Professor",
  "telephone": "(425) 123-4567",
  "url": "http://www.janedoe.com"
}
```

```
>>> test(person)
(<http://xmlns.com/foaf/0.1/person-1>,
<http://schema.org/name>, "Jane Doe")
(<http://xmlns.com/foaf/0.1/person-1>,
<http://schema.org/jobTitle>, "Professor")
(<http://xmlns.com/foaf/0.1/person-1>,
<http://schema.org/telephone>, "(425) 123-4567")
(<http://xmlns.com/foaf/0.1/person-1>,
<http://schema.org/url>, <http://www.janedoe.com>)
```

```
(<http://xmlns.com/foaf/0.1/person-1>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://schema.org/Person>)
```

Improving Performance by Adding Lists

Adding one person at a time requires doing an interaction with the server for each person. It is much more efficient to add lists of objects all at once rather than one at a time. Note that `addData` will take a list of dicts and still do the right thing. So let us add a 1000 persons at the same time, each person being a copy of the above person but with a different `@id`. (The example code is repeated below for ease of copying.)

```
>>> x = [copy.deepcopy(person) for i in range(1000)]
>>> len(x)
1000
>>> c = 0
>>> for el in x:
    el['@id'] = "http://franz.com/person-" + str(c)
    c = c + 1
>>> test(x,maxPrint=10)
(<http://franz.com/person-0>, <http://schema.org/name>, "Jane
Doe")
(<http://franz.com/person-0>, <http://schema.org/jobTitle>,
"Professor")
(<http://franz.com/person-0>, <http://schema.org/telephone>,
"(425) 123-4567")
(<http://franz.com/person-0>, <http://schema.org/url>,
<http://www.janedoe.com>)
(<http://franz.com/person-0>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://schema.org/Person>)
(<http://franz.com/person-1>, <http://schema.org/name>, "Jane
Doe")
(<http://franz.com/person-1>, <http://schema.org/jobTitle>,
"Professor")
(<http://franz.com/person-1>, <http://schema.org/telephone>,
```



```
"(425) 123-4567")
(<http://franz.com/person-1>, <http://schema.org/url>,
<http://www.janedoe.com>)
(<http://franz.com/person-1>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://schema.org/Person>)
>>> conn.size()
5000
>>>
```

```
x = [copy.deepcopy(person) for i in range(1000)]
len(x)
```

```
c = 0
for el in x:
    el['@id'] = "http://franz.com/person-" + str(c)
    c = c + 1
```

```
test(x,maxPrint=10)
```

```
conn.size()
```

Adding a Context Directly to an Object

You can download a context directly in Python, modify it and then add it to the object you want to store. As an illustration we load a person context from json-ld.org (actually a fragment of the schema.org context) and insert it in a person object. (We have broken and truncated some output lines for clarity and all the code executed is repeated below for ease of copying.)

```
>>>
context=requests.get("https://json-ld.org/contexts/person.json
ld").json()['@context']
>>> context
{'Person': 'http://xmlns.com/foaf/0.1/Person',
 'xsd': 'http://www.w3.org/2001/XMLSchema#',
 'name': 'http://xmlns.com/foaf/0.1/name',
```

```
'jobTitle': 'http://xmlns.com/foaf/0.1/title',
'telephone': 'http://schema.org/telephone',
'nickname': 'http://xmlns.com/foaf/0.1/nick',
'affiliation': 'http://schema.org/affiliation',
'depiction': {'@id': 'http://xmlns.com/foaf/0.1/depiction',
 '@type': '@id'},
'image': {'@id': 'http://xmlns.com/foaf/0.1/img', '@type':
 '@id'},
'born': {'@id': 'http://schema.org/birthDate', '@type':
'xsd:date'},
...}
```

```
>>> person = {
    "@context": context,
    "@type": "Person",
    "@id": "foaf:person-1",
    "name": "Jane Doe",
    "jobTitle": "Professor",
    "telephone": "(425) 123-4567",
}
```

```
>>> test(person)
(<http://xmlns.com/foaf/0.1/person-1>,
<http://xmlns.com/foaf/0.1/name>, "Jane Doe")
(<http://xmlns.com/foaf/0.1/person-1>,
<http://xmlns.com/foaf/0.1/title>, "Professor")
(<http://xmlns.com/foaf/0.1/person-1>,
<http://schema.org/telephone>, "(425) 123-4567")
(<http://xmlns.com/foaf/0.1/person-1>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://xmlns.com/foaf/0.1/Person>)
>>>
```

```
context=requests.get("https://json-ld.org/context/person.json
ld").json()['@context']
```

```
# The next produces lots of output, uncomment if desired
```

```
#context
```

```
person = {
    "@context": context,
    "@type": "Person",
    "@id": "foaf:person-1",
    "name": "Jane Doe",
```

```
    "jobTitle": "Professor",
    "telephone": "(425) 123-4567",
  }
test(person)
```

Building a Graph of Objects

We start by forcing a key's value to be stored as a resource. We saw above that we could specify the value of a key to be a date using the `xsd:dateTime` specification. We now do it again for `foaf:birthdate`. Then we created several linked objects and show the connections using Gruff.

```
context = { "foaf:child": {"@type": "@id"},
            "foaf:brotherOf": {"@type": "@id"},
            "foaf:birthdate": {"@type": "xsd:dateTime"}}
```

```
p1 = {
  "@context": context,
  "@type": "foaf:Person",
  "@id": "foaf:person-1",
  "foaf:birthdate": "1958-04-09T20:00:00Z",
  "foaf:child": ['foaf:person-2', 'foaf:person-3']
}
```

```
p2 = {
  "@context": context,
  "@type": "foaf:Person",
  "@id": "foaf:person-2",
  "foaf:brotherOf": "foaf:person-3",
  "foaf:birthdate": "1992-04-09T20:00:00Z",
}
```

```
p3 = {"@context": context,
      "@type": "foaf:Person",
      "@id": "foaf:person-3",
      "foaf:birthdate": "1994-04-09T20:00:00Z",
}
```

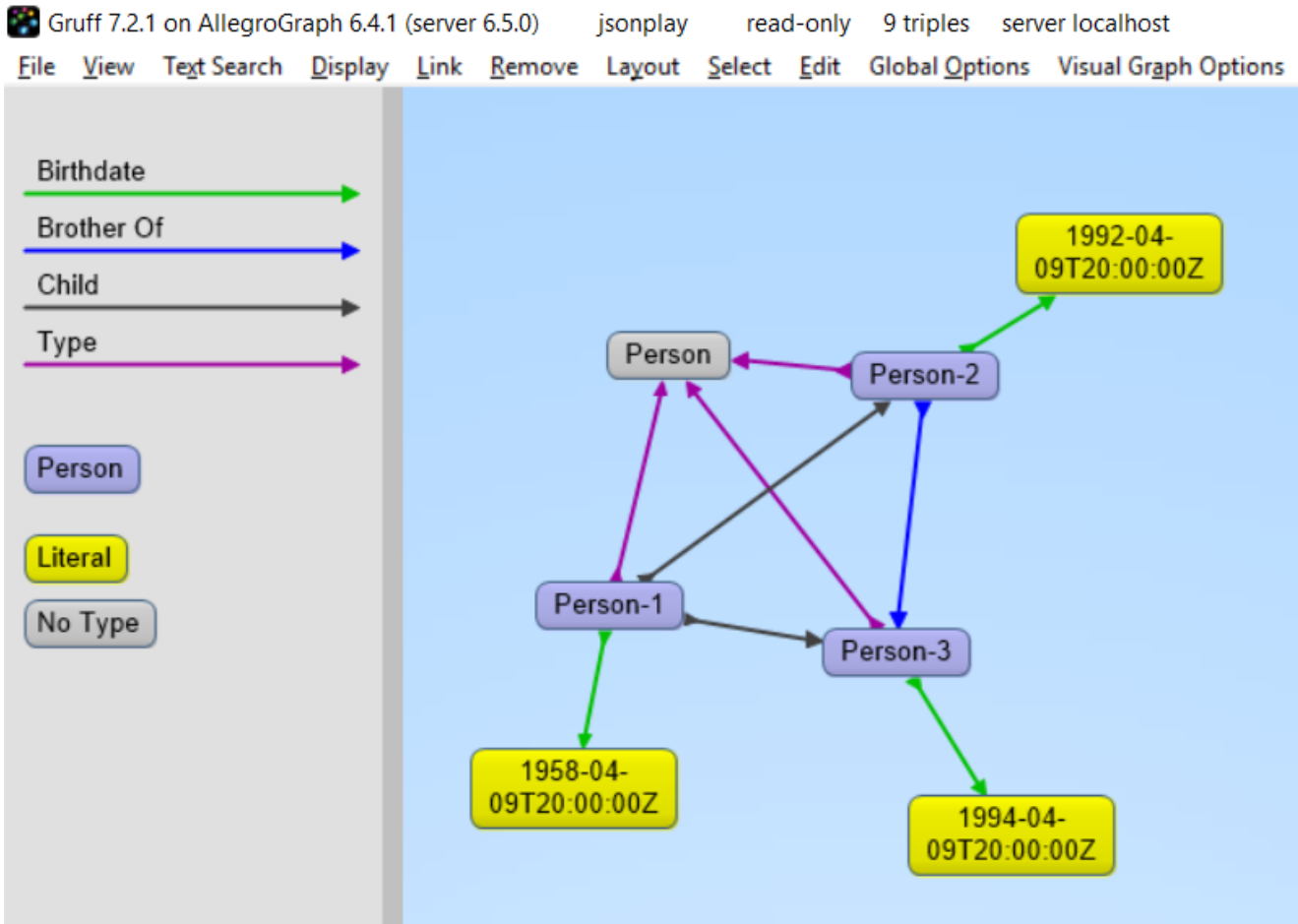
```
test([p1,p2,p3])
```

```

>>> test([p1,p2,p3])
(<http://xmlns.com/foaf/0.1/person-1>,
<http://xmlns.com/foaf/0.1/birthdate>,
"1958-04-09T20:00:00Z"^^<http://www.w3.org/2001/XMLSchema#date
Time>)
(<http://xmlns.com/foaf/0.1/person-1>,
<http://xmlns.com/foaf/0.1/child>,
<http://xmlns.com/foaf/0.1/person-2>)
(<http://xmlns.com/foaf/0.1/person-1>,
<http://xmlns.com/foaf/0.1/child>,
<http://xmlns.com/foaf/0.1/person-3>)
(<http://xmlns.com/foaf/0.1/person-1>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://xmlns.com/foaf/0.1/Person>)
(<http://xmlns.com/foaf/0.1/person-2>,
<http://xmlns.com/foaf/0.1/brotherOf>,
<http://xmlns.com/foaf/0.1/person-3>)
(<http://xmlns.com/foaf/0.1/person-2>,
<http://xmlns.com/foaf/0.1/birthdate>,
"1992-04-09T20:00:00Z"^^<http://www.w3.org/2001/XMLSchema#date
Time>)
(<http://xmlns.com/foaf/0.1/person-2>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://xmlns.com/foaf/0.1/Person>)
(<http://xmlns.com/foaf/0.1/person-3>,
<http://xmlns.com/foaf/0.1/birthdate>,
"1994-04-09T20:00:00Z"^^<http://www.w3.org/2001/XMLSchema#date
Time>)
(<http://xmlns.com/foaf/0.1/person-3>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://xmlns.com/foaf/0.1/Person>)

```

The following shows the graph that we created in Gruff. Note that this is what JSON-LD is all about: connecting objects together.



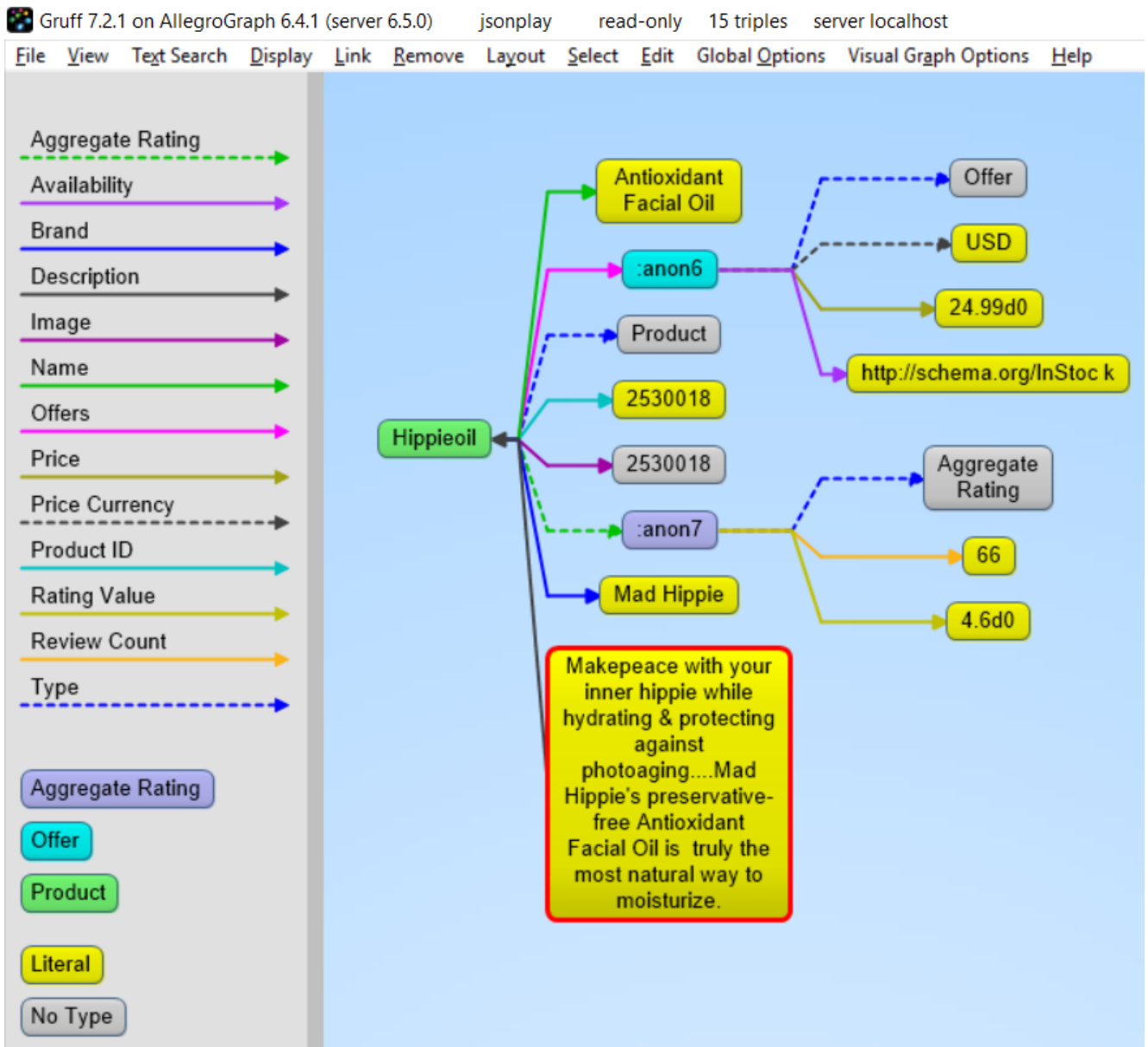
JSON-LD Keyword Directives can be Added at any Level

Here is an example from the wild. The URL <https://www.ulta.com/antioxidant-facial-oil?productId=xlsImpprod18731241> goes to a web page advertising a facial oil. (We make no claims or recommendations about this product. We are simply showing how JSON-LD appears in many places.) Look at the source of the page and you'll find a JSON-LD object similar to the following. Note that @ directives go to any level. We added an @id key.

```
hippieoil = {"@context":"http://schema.org",
  "@type":"Product",
  "@id":"http://franz.com/hippieoil",
  "aggregateRating":
    {"@type":"AggregateRating",
     "ratingValue":4.6,
```

```
"reviewCount":73},
  "description":"""Make peace with your inner hippie while
hydrating & protecting against photoaging....Mad Hippie's
preservative-free Antioxidant Facial Oil is truly the most
natural way to moisturize.""",
  "brand":"Mad Hippie",
  "name":"Antioxidant Facial Oil",
  "image":"https://images.ultra.com/is/image/Ulta/2530018",
  "productID":"2530018",
  "offers":
    {"@type":"Offer",
      "availability":"http://schema.org/InStock",
      "price":"24.99",
      "priceCurrency":"USD"}}
```

```
test(hippieoil)
```



JSON-LD @graphs

One can put one or more JSON-LD objects in an RDF named graph. This means that the fourth element of each triple generated from a JSON-LD object will have the specified graph name. Let's show in an example.

```
context = {
  "name": "http://schema.org/name",
  "description": "http://schema.org/description",
  "image": {
    "@id": "http://schema.org/image", "@type": "@id"
  },
}
```

```

    "geo": "http://schema.org/geo",
    "latitude": {
        "@id": "http://schema.org/latitude", "@type":
"xsd:float" },
    "longitude": {
        "@id": "http://schema.org/longitude", "@type":
"xsd:float" },
    "xsd": "http://www.w3.org/2001/XMLSchema#"
}

```

```

place = {
    "@context": context,
    "@id": "http://franz.com/place1",
    "@graph": {
        "@id": "http://franz.com/place1",
        "@type": "http://franz.com/Place",
        "name": "The Empire State Building",
        "description": "The Empire State Building is a 102-
story landmark in New York City.",
        "image":
"http://www.civil.usherbrooke.ca/cours/gci215a/empire-state-bu
ilding.jpg",
        "geo": {
            "latitude": "40.75",
            "longitude": "73.98" }
    }}

```

and here is the result:

```

>>> test(place, maxPrint=3)
(<http://franz.com/place1>, <http://schema.org/name>, "The
Empire State Building", <http://franz.com/place1>)
(<http://franz.com/place1>, <http://schema.org/description>,
"The Empire State Building is a 102-story landmark in New York
City.", <http://franz.com/place1>)
(<http://franz.com/place1>, <http://schema.org/image>,
<http://www.civil.usherbrooke.ca/cours/gci215a/empire-state-bu
ilding.jpg>, <http://franz.com/place1>)
>>>

```

Note that the fourth element (graph) of each of the triples is

<http://franz.com/placel>. If you don't add the @id the triples will be put in the default graph.

Here a slightly more complex example:

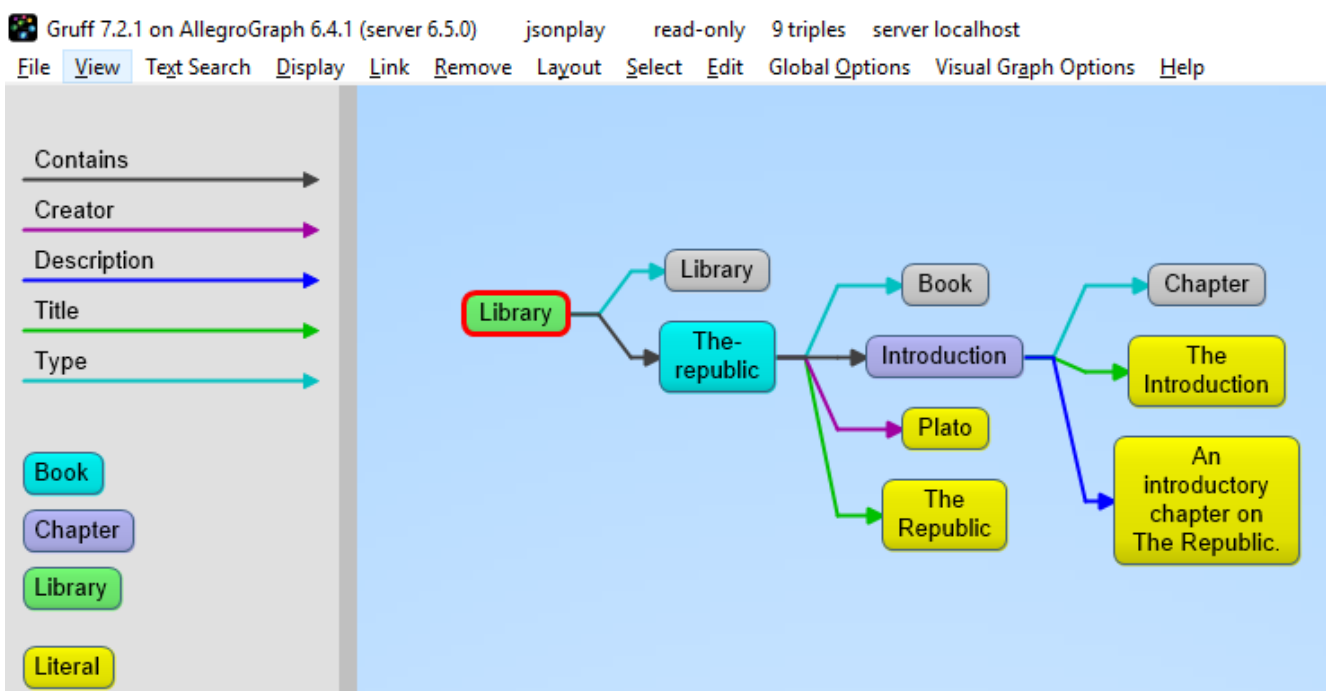
```
library = {
  "@context": {
    "dc": "http://purl.org/dc/elements/1.1/",
    "ex": "http://example.org/vocab#",
    "xsd": "http://www.w3.org/2001/XMLSchema#",
    "ex:contains": {
      "@type": "@id"
    }
  },
  "@id": "http://franz.com/mygraph1",
  "@graph": [
    {
      "@id": "http://example.org/library",
      "@type": "ex:Library",
      "ex:contains": "http://example.org/library/the-republic"
    },
    {
      "@id": "http://example.org/library/the-republic",
      "@type": "ex:Book",
      "dc:creator": "Plato",
      "dc:title": "The Republic",
      "ex:contains":
"http://example.org/library/the-republic#introduction"
    },
    {
      "@id":
"http://example.org/library/the-republic#introduction",
      "@type": "ex:Chapter",
      "dc:description": "An introductory chapter on The
Republic.",
      "dc:title": "The Introduction"
    }
  ]
}
```

With the result:

```

>>> test(library, maxPrint=3)
(<http://example.org/library>,
<http://example.org/vocab#contains>,
<http://example.org/library/the-republic>,
<http://franz.com/mygraph1>) (<http://example.org/library>,
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>,
<http://example.org/vocab#Library>,
<http://franz.com/mygraph1>)
(<http://example.org/library/the-republic>,
<http://purl.org/dc/elements/1.1/creator>,
"Plato", <http://franz.com/mygraph1>)
>>>

```



JSON-LD as a Document Store

So far we have treated JSON-LD as a syntax to create triples. Now let us look at the way we can start using AllegroGraph as a combination of a document store and graph database at the same time. And also keep in mind that we want to do it in such a way that you as a Python developer can add documents such as dictionaries and also retrieve values or documents as dictionaries.

Setup

The Python source file `jsonld_tutorial_helper.py` contains various definitions useful for the remainder of this example. Once it is downloaded, do the following (after adding the path to the filename):

```
conn=createdb("docugraph")
from jsonld_tutorial_helper import *
addNamespace(conn,"jsonldmeta","http://franz.com/ns/allegrograph/6.4/load-meta#")
addNamespace(conn,"ical","http://www.w3.org/2002/12/cal/ical#"
)
```

Let's use our event structure again and see how we can store this JSON document in the store as a document. Note that the `addData` call includes the keyword: `json_ld_store_source=True`.

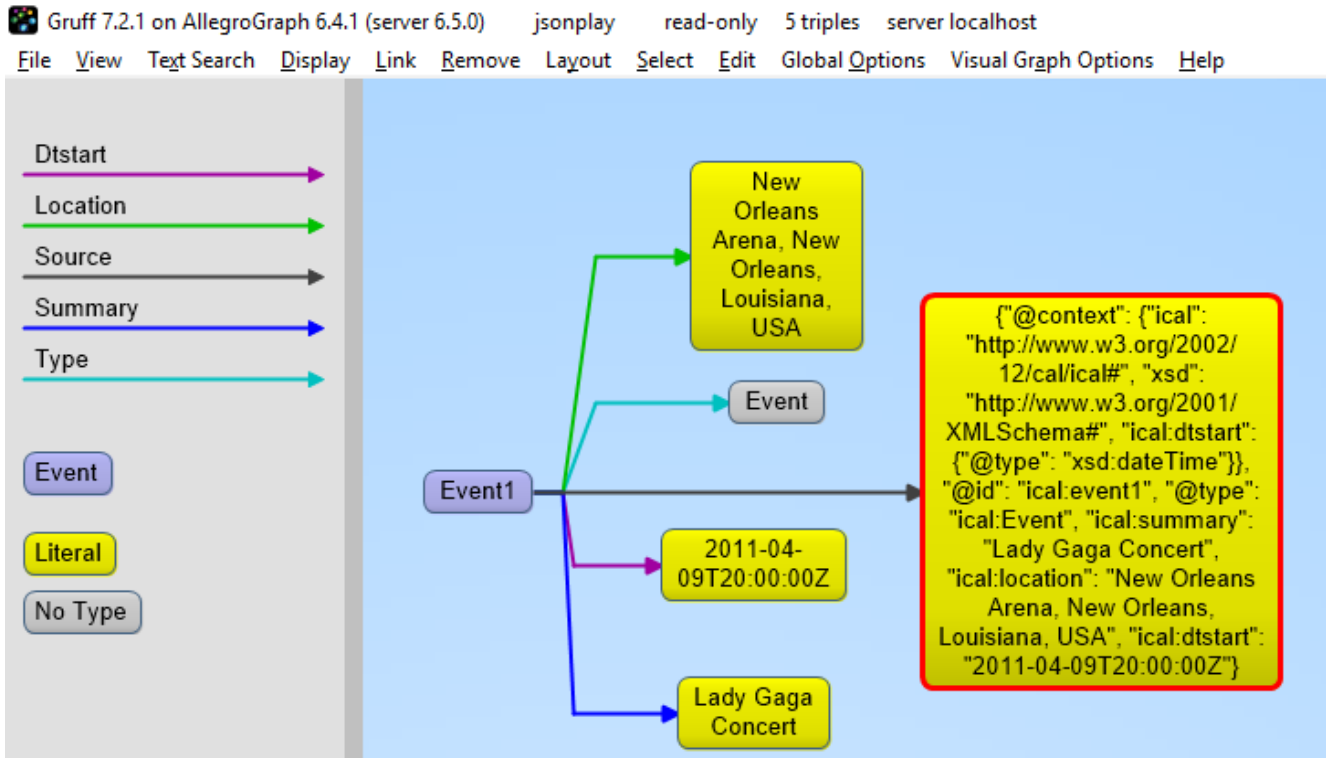
```
event = {
  "@context": {
    "@id": "ical:event1",
    "@type": "ical:Event",
    "ical": "http://www.w3.org/2002/12/cal/ical#",
    "xsd": "http://www.w3.org/2001/XMLSchema#",
    "ical:dtstart": { "@type": "xsd:dateTime" }
  },
  "ical:summary": "Lady Gaga Concert",
  "ical:location":
  "New Orleans Arena, New Orleans, Louisiana, USA",
  "ical:dtstart": "2011-04-09T20:00:00Z"
}
```

```
>>> conn.addData(event,
allow_external_references=True,json_ld_store_source=True)
```

The `jsonld_tutorial_helper.py` file defines the function `store` as simple wrapper around `addData` that always saves the JSON source. For experimentation reasons it also has a parameter `fresh` to clear out the repository first.

```
>>> store(conn,event, fresh=True)
```

If we look at the triples in Gruff we see that the JSON source is stored as well, on the root (top-level `@id`) of the JSON object.



For the following part of the tutorial we want a little bit more data in our repository so please look at the helper file `jsonld_tutorial_helper.py` where you will see that at the end we have a dictionary named `obs` with about 9 diverse objects, mostly borrowed from the `json-ld.org` site: a person, an event, a place, a recipe, a group of persons, a product, and our hippieoil.

First let us store all the objects in a fresh repository. Then we check the size of the repo. Finally, we create a freetext index for the JSON sources.

```
>>> store(conn,[v for k,v in obs.items()], fresh=True)
>>> conn.size()
86
>>>
conn.createFreeTextIndex("source",['<http://franz.com/ns/alleg
```

```
rograph/6.4/load-meta#source>']])
```

```
>>>
```

Retrieving values with SPARQL

To simply retrieve values in objects but not the objects themselves, regular SPARQL queries will suffice. But because we want to make sure that Python developers only need to deal with regular Python structures as lists and dictionaries, we created a simple wrapper around SPARQL (see helper file). The name of the wrapper is `runSparql`.

Here is an example. Let us find all the roots (top-level *@ids*) of objects and their types. Some objects do not have roots, so `None` stands for a blank node.

```
>>> pprint(runSparql(conn,"select ?s ?type { ?s a ?type }"))
[{'s': 'cocktail1', 'type': 'Cocktail'},
 {'s': None, 'type': 'Individual'},
 {'s': None, 'type': 'Vehicle'},
 {'s': 'tesla', 'type': 'Offering'},
 {'s': 'place1', 'type': 'Place'},
 {'s': None, 'type': 'Offer'},
 {'s': None, 'type': 'AggregateRating'},
 {'s': 'hippieoil', 'type': 'Product'},
 {'s': 'person-3', 'type': 'Person'},
 {'s': 'person-2', 'type': 'Person'},
 {'s': 'person-1', 'type': 'Person'},
 {'s': 'person-1000', 'type': 'Person'},
 {'s': 'event1', 'type': 'Event'}]
>>>
```

We do not see the full URIs for `?s` and `?type`. You can see them by adding an appropriate *format* argument to `runSparql`, but the default is terse.

```
>>> pprint(runSparql(conn,"select ?s ?type { ?s a ?type }
limit 2",format='ntriples'))
[{'s': '<http://franz.com/cocktail1>', 'type':
```

```
'<http://franz.com/Cocktail>'},
      {'s': None, 'type':
'<http://purl.org/goodrelations/v1#Individual>'}]}
>>>
```

Retrieving a Dictionary or Object

`retrieve` is another function defined (in `jsonld_tutorial_helper.py`) for this tutorial. It is a wrapper around SPARQL to help extract objects. Here we see how we can use it. The sole purpose of `retrieve` is to retrieve the JSON-LD/dictionary based on a SPARQL pattern.

```
>>> retrieve(conn,"{?this a ical:Event}")
[{'@type': 'ical:Event', 'ical:location': 'New Orleans Arena,
New Orleans, Louisiana, USA', 'ical:summary': 'Lady Gaga
Concert', '@id': 'ical:event1', '@context': {'xsd':
'http://www.w3.org/2001/XMLSchema#', 'ical':
'http://www.w3.org/2002/12/cal/ical#', 'ical:dtstart':
{'@type': 'xsd:dateTime'}}, 'ical:dtstart':
'2011-04-09T20:00:00Z'}]}
>>>
```

Ok, for a final fun (if you like expensive cars) example: Let us find a thing that is “fast and furious”, that is worth more than \$80,000 and that we can pay for in cash:

```
>>>
addNamespace(conn,"gr","http://purl.org/goodrelations/v1#")
>>> x = retrieve(conn, """"{ ?this fti:match 'fast furious*';
      gr:acceptedPaymentMethods gr:Cash ;
      gr:hasPriceSpecification ?price .
      ?price gr:hasCurrencyValue ?value ;
      gr:hasCurrency "USD" .
      filter ( ?value > 80000.0 ) }""")
>>> pprint(x)
[{'@context': {'foaf': 'http://xmlns.com/foaf/0.1/',
'foaf:page': {'@type': '@id'},
'gr': 'http://purl.org/goodrelations/v1#',
```

```
        'gr:acceptedPaymentMethods': {'@type': '@id'},
        'gr:hasBusinessFunction': {'@type': '@id'},
        'gr:hasCurrencyValue': {'@type': 'xsd:float'},
        'pto': 'http://www.productontology.org/id/',
        'xsd': 'http://www.w3.org/2001/XMLSchema#'},
    '@id': 'http://example.org/cars/for-sale#tesla',
    '@type': 'gr:Offering',
    'gr:acceptedPaymentMethods': 'gr:Cash',
    'gr:description': 'Need to sell fast and furiously',
    'gr:hasBusinessFunction': 'gr:Sell',
    'gr:hasPriceSpecification': {'gr:hasCurrency': 'USD',
                                  'gr:hasCurrencyValue':
'85000'},
    'gr:includes': {'@type': ['gr:Individual', 'pto:Vehicle'],
                    'foaf:page':
'http://www.teslamotors.com/roadster',
                    'gr:name': 'Tesla Roadster'},
    'gr:name': 'Used Tesla Roadster'}}
>>> x[0]['@id']
'http://example.org/cars/for-sale#tesla'
```