INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

Aula prática 5

RDF

Representação e Processamento do Conhecimento

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1. Testar diretiva SPARQL por interação com “SPARQL-endpoint”

label
"Asturias"@en
"منطقة أسْتورية"@ar
"Astúries"@ca
"Asturie"@cs
"Asturien"@de
"Αστούριες"@el
"Asturio"@eo
"Asturias"@es
"Asturiasko Printzerria"@eu
"Asturies"@fr
"Asturias"@ga
"Asturias"@in
"アストゥリアス州"@ja
"Asturie"@it
"Asturië (regio)"@nl
"Asturia"@pl
"Astúrias"@pt
"Астурия"@ru
"Asturien"@sv
"Астурія"@uk
"阿斯图里亚斯"@zh

*Figura 1 - dbpedia.org/sparql **resposta à query***

2. O “SPARQLWrapper” e os formatos JSON e XML

```
*** Exemplo JSON
{'head': {'link': [], 'vars': ['label']}, 'results': {'distinct': False, 'ordered': True, 'bindings': [{'label': {'type': 'literal', 'xml:lang': 'en', 'value': 'Asturias'}}, {'label': {'type': 'literal', 'xml:lang': 'ar', 'value': 'منطقة أسْتورية'}}, {'label': {'type': 'literal', 'xml:lang': 'ca', 'value': 'Astúries'}}, {'label': {'type': 'literal', 'xml:lang': 'cs', 'value': 'Asturie'}}, {'label': {'type': 'literal', 'xml:lang': 'de', 'value': 'Asturien'}}, {'label': {'type': 'literal', 'xml:lang': 'el', 'value': 'Αστούριες'}}, {'label': {'type': 'literal', 'xml:lang': 'eo', 'value': 'Asturio'}}, {'label': {'type': 'literal', 'xml:lang': 'es', 'value': 'Asturias'}}, {'label': {'type': 'literal', 'xml:lang': 'eu', 'value': 'Asturiasko Printzerria'}}, {'label': {'type': 'literal', 'xml:lang': 'fr', 'value': 'Asturies'}}, {'label': {'type': 'literal', 'xml:lang': 'ga', 'value': 'Asturias'}}, {'label': {'type': 'literal', 'xml:lang': 'in', 'value': 'Asturias'}}, {'label': {'type': 'literal', 'xml:lang': 'ja', 'value': 'アストゥリアス州'}}, {'label': {'type': 'literal', 'xml:lang': 'it', 'value': 'Asturie'}}, {'label': {'type': 'literal', 'xml:lang': 'ko', 'value': '아스투리아스 지방'}}, {'label': {'type': 'literal', 'xml:lang': 'nl', 'value': 'Asturië (regio)'}}, {'label': {'type': 'literal', 'xml:lang': 'pl', 'value': 'Asturia'}}, {'label': {'type': 'literal', 'xml:lang': 'pt', 'value': 'Astúrias'}}, {'label': {'type': 'literal', 'xml:lang': 'ru', 'value': 'Астурия'}}, {'label': {'type': 'literal', 'xml:lang': 'sv', 'value': 'Asturien'}}, {'label': {'type': 'literal', 'xml:lang': 'uk', 'value': 'Астурія'}}, {'label': {'type': 'literal', 'xml:lang': 'zh', 'value': '阿斯图里亚斯'}}]}}
Asturias
منطقة أسْتورية
Astúries
Asturie
Asturien
Αστούριες
Asturio
Asturias
Asturiasko Printzerria
Asturies
Asturias
Asturias
アストゥリアス州
Asturie
아스투리아스 지방
Asturië (regio)
Asturia
Astúrias
Астурия
Asturien
Астурія
阿斯图里亚斯
```

Figura 2 - “SPARQLWrapper” em JSON

```
*** Exemplo XML
<sparql xmlns="http://www.w3.org/2005/sparql-results#" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.w3.org/2001/sw/DataAccess/rf1/result2.xsd
">

 <head>

  <variable name="label"/>

 </head>

 <results distinct="false" ordered="true">

  <result>

   <binding name="label"><literal xml:lang="en">Asturias</literal></binding>

  </result>

  <result>

   <binding name="label"><literal xml:lang="ar">منطقة أشتورية</literal></binding>

  </result>

  <result>

   <binding name="label"><literal xml:lang="ca">Astúries</literal></binding>

  </result>
```

Figura 3 - "SPARQLWrapper" em XML

3. Formato N3, conversão e desenho do Grafo

```
*** Exemplo N3
/home/obilys/git/ISEL-RPC/venv/lib/python3.6/site-packages/SPARQLWrapper/Wrapper.py:573: RuntimeWarning: Sending Accept header '*/*' because unexpected returned format 'n3' in a 'SE
LECT' SPARQL query form
  warnings.warn("Sending Accept header '*/*' because unexpected returned format '%s' in a '%s' SPARQL query form" % (self.returnFormat, self.queryType), RuntimeWarning)
b'@prefix res: <http://www.w3.org/2005/sparql-results#> .\n@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .\n_:_ a res:ResultSet .\n_:_ res:resultVariable "label" .\n_:_
 res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturias"@en ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "\\u0645\\u0646\\
u0637\\u0642\\u0629 \\u0623\\u0634\\u062A\\u0648\\u0631\\u064A\\u0629"@ar ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Ast\\u00FAries"@ca ] ] .\n
_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturie"@cs ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturien"@de ]
 ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "\\u0391\\u03C3\\u03C4\\u03BF\\u03CD\\u03C1\\u03B9\\u03B5\\u03C2"@el ] ] .\n_:_ res:solution [\n
res:binding [ res:variable "label" ; res:value "Asturio"@eo ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturias"@es ] ] .\n_:_ res:solution [\n
      res:binding [ res:variable "label" ; res:value "Asturiasko Printzerria"@eu ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturies"@fr ] ] .\
n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturias"@ga ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturias"@in
 ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "\\u30A2\\u30B9\\u30C8\\u30A5\\u30EA\\u30A2\\u30B9\\u5DDE"@ja ] ] .\n_:_ res:solution [\n      res:b
inding [ res:variable "label" ; res:value "Asturie"@it ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "\\uC544\\uC2A4\\uD22C\\uB9AC\\uC544\\uC2A4 \\
uC9C0\\uBC29"@ko ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturi\\u00EB (regio)"@nl ] ] .\n_:_ res:solution [\n      res:binding [ res:variab
le "label" ; res:value "Asturia"@pl ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Ast\\u00FArias"@pt ] ] .\n_:_ res:solution [\n      res:binding
[ res:variable "label" ; res:value "\\u0410\\u0441\\u0442\\u0443\\u0440\\u0438\\u044F"@ru ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "Asturien"@
sv ] ] .\n_:_ res:solution [\n      res:binding [ res:variable "label" ; res:value "\\u0410\\u0441\\u0442\\u0443\\u0440\\u0456\\u044F"@uk ] ] .\n_:_ res:solution [\n      res:bindin
g [ res:variable "label" ; res:value "\\u963F\\u65AF\\u56FE\\u91CC\\u4E9A\\u65AF"@zh ] ] .\n'
```

Figura 4 - "SPARQLWrapper" em N3

```
*** Grafo RFF (a partir da descricao N3)
('ub1bL44C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL45C19')
('ub1bL19C19', 'http://www.w3.org/2005/sparql-results#value', 'Asturias')
('ub1bL45C19', 'http://www.w3.org/2005/sparql-results#value', 'Астурія')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL32C18')
('ub1bL33C19', 'http://www.w3.org/2005/sparql-results#variable', 'label')
('ub1bL11C19', 'http://www.w3.org/2005/sparql-results#variable', 'label')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL16C18')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL18C18')
('ub1bL41C19', 'http://www.w3.org/2005/sparql-results#value', 'Астурия')
('ub1bL34C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL35C19')
('ub1bL5C19', 'http://www.w3.org/2005/sparql-results#value', 'Asturias')
('ub1bL31C19', 'http://www.w3.org/2005/sparql-results#variable', 'label')
('ub1bL43C19', 'http://www.w3.org/2005/sparql-results#value', 'Asturien')
('ub1bL17C19', 'http://www.w3.org/2005/sparql-results#variable', 'label')
('ub1bL30C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL31C19')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL38C18')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL20C18')
('ub1bL21C19', 'http://www.w3.org/2005/sparql-results#variable', 'label')
('ub1bL36C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL37C19')
('ub1bL38C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL39C19')
('ub1bL46C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL47C19')
('ub1bL6C18', 'http://www.w3.org/2005/sparql-results#binding', 'ub1bL7C19')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL8C18')
('ub1bL39C19', 'http://www.w3.org/2005/sparql-results#value', 'Astúrias')
('ub1bL45C19', 'http://www.w3.org/2005/sparql-results#variable', 'label')
('ub1bL47C19', 'http://www.w3.org/2005/sparql-results#value', '阿斯图里亚斯')
('f0f31f146be8d4f2eb871e067871d3dc0b1', 'http://www.w3.org/2005/sparql-results#solution', 'ub1bL22C18')
```

Figura 5 - "SPARQLWrapper" em Grafo

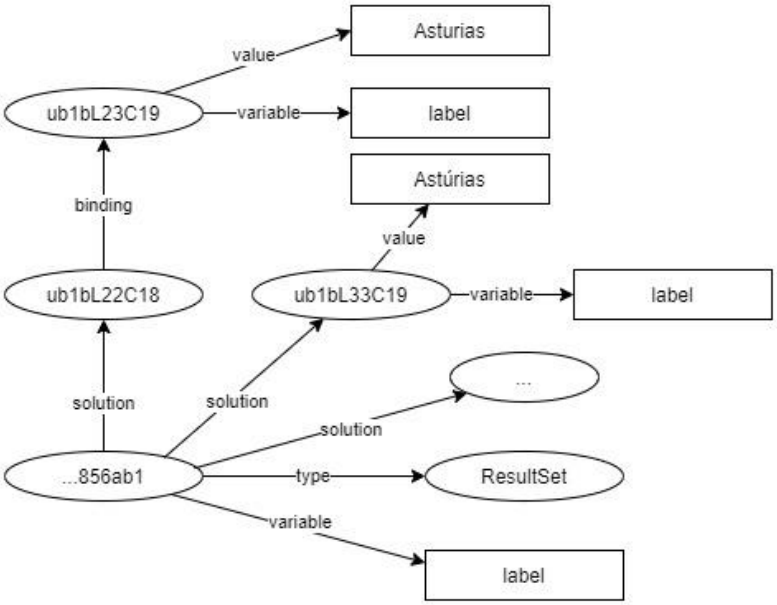

Figura 6 - Grafo gerado pela resposta da diretiva SPARQL

4. Formato JSON-LD e “fallback” para o reconhecido pelo “endpoint”

```
*** Exemplo JSON-LD
/home/obilys/git/ISEL-RPC/venv/lib/python3.6/site-packages/SPARQLWrapper/Wrapper.py:573: RuntimeWarning: Sending Accept header '*/*' because unexpected returned format 'json-ld' in a 'SELECT' SPARQL query form
  warnings.warn("Sending Accept header '*/*' because unexpected returned format '%s' in a '%s' SPARQL query form" % (self.returnFormat, self.queryType), RuntimeWarning)
Fazer "fallback" de JSON-LD para XML dependendo do suporte do endpoint
>>> endpoint nao suporta JSONLD
<?xml version="1.0" ?><sparql xmlns="http://www.w3.org/2005/sparql-results#" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.w3.org/2001/sw/DataAccess/rf1/result2.xsd">
 <head>
  <variable name="label"/>
 </head>
 <results distinct="false" ordered="true">
  <result>
   <binding name="label"><literal xml:lang="en">Asturias</literal></binding>
  </result>
  <result>
   <binding name="label"><literal xml:lang="ar">ةيروحض أ ةقطنم</literal></binding>
  </result>
  <result>
   <binding name="label"><literal xml:lang="ca">Astúries</literal></binding>
  </result>
  <result>
   <binding name="label"><literal xml:lang="cs">Asturie</literal></binding>
  </result>
  <result>
   <binding name="label"><literal xml:lang="de">Asturien</literal></binding>
  </result>
  <result>
```

Figura 7 - “SPARQLWrapper” em JSON-LD

5. ... estrutura JSON e transformação em “lista-de-listas”

```
*** Exemplo JSON
* http://dbpedia.org/resource/Rafael_Fernández_Álvarez ** http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party
* http://dbpedia.org/resource/Avelino_González_Mallada ** http://dbpedia.org/resource/Confederación_Nacional_del_Trabajo
* http://dbpedia.org/resource/Ignacio_Prendes ** C's
* http://dbpedia.org/resource/Javier_Fernández_(Spanish_politician) ** http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party
* http://dbpedia.org/resource/Santiago_Carrillo ** http://dbpedia.org/resource/Workers'_Party_of_Spain-Communist_Unity
* http://dbpedia.org/resource/Santiago_Carrillo ** http://dbpedia.org/resource/Communist_Party_of_Spain
* http://dbpedia.org/resource/Antonio_Trevín ** http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party
* http://dbpedia.org/resource/Aurelio_Fernández_Sánchez ** http://dbpedia.org/resource/Federación_Anarquista_Ibérica
* http://dbpedia.org/resource/Ramón_Álvarez_Palomo ** CGT
* http://dbpedia.org/resource/Ramón_Álvarez_Palomo ** http://dbpedia.org/resource/Confederación_Nacional_del_Trabajo
* http://dbpedia.org/resource/Adrián_Barbón ** http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party
* http://dbpedia.org/resource/Sergio_Marqués_Fernández ** http://dbpedia.org/resource/Asturian_Renewal_Union
* http://dbpedia.org/resource/Sergio_Marqués_Fernández ** http://dbpedia.org/resource/People's_Party_(Spain)
* http://dbpedia.org/resource/Vicente_Álvarez_Areces ** http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party
* http://dbpedia.org/resource/Emilio_Eiroa ** http://dbpedia.org/resource/Aragonese_Party



>>> usar a funcao getResultSet implementada em x_util_JSON.py
['http://dbpedia.org/resource/Rafael_Fernández_Álvarez', "http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party", 'Rafael Fernández Álvarez']
['http://dbpedia.org/resource/Avelino_González_Mallada', 'http://dbpedia.org/resource/Confederación_Nacional_del_Trabajo', 'Avelino González Mallada']
['http://dbpedia.org/resource/Ignacio_Prendes', "C's", 'Ignacio Prendes']
['http://dbpedia.org/resource/Javier_Fernández_(Spanish_politician)', "http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party", 'Javier Fernández']
['http://dbpedia.org/resource/Santiago_Carrillo', "http://dbpedia.org/resource/Workers'_Party_of_Spain-Communist_Unity", 'Santiago Carrillo']
['http://dbpedia.org/resource/Santiago_Carrillo', 'http://dbpedia.org/resource/Communist_Party_of_Spain', 'Santiago Carrillo']
['http://dbpedia.org/resource/Antonio_Trevín', "http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party", 'Antonio Trevín']
['http://dbpedia.org/resource/Aurelio_Fernández_Sánchez', 'http://dbpedia.org/resource/Federación_Anarquista_Ibérica', 'Aurelio Fernández Sánchez']
['http://dbpedia.org/resource/Ramón_Álvarez_Palomo', 'CGT', 'Ramón Álvarez Palomo']
['http://dbpedia.org/resource/Ramón_Álvarez_Palomo', 'http://dbpedia.org/resource/Confederación_Nacional_del_Trabajo', 'Ramón Álvarez Palomo']
['http://dbpedia.org/resource/Adrián_Barbón', "http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party", 'Adrián Barbón']
['http://dbpedia.org/resource/Sergio_Marqués_Fernández', 'http://dbpedia.org/resource/Asturian_Renewal_Union', 'Sergio Marqués Fernández']
['http://dbpedia.org/resource/Sergio_Marqués_Fernández', "http://dbpedia.org/resource/People's_Party_(Spain)", 'Sergio Marqués Fernández']
['http://dbpedia.org/resource/Vicente_Álvarez_Areces', "http://dbpedia.org/resource/Spanish_Socialist_Workers'_Party", 'Vicente Álvarez Areces']
['http://dbpedia.org/resource/Emilio_Eiroa', 'http://dbpedia.org/resource/Aragonese_Party', 'Emilio Eiroa']
```

Figura 8 - Extensão do código do ficheiro 'a02_SPARQLendpoint_DBPedia_B.py' e adicao de myZ

6. “Linked Data” – exploração (programática) do repositório RDF4J

```
My endpoint:
http://localhost:8280/rdf4j-server/repositories/repo-con

*** Exemplo JSON:
http://critica/#Pedro | Fabuloso

Uso de: getResultSet()
['http://critica/#Pedro', 'http://critica/#dizer', 'http://map/#Londres',
'http://critica/#achar', 'http://critica/#ser', 'Fabuloso']

*** Exemplo JSON\XML:
<?xml version="1.0" ?><sparql xmlns="http://www.w3.org/2005/sparql-results#">
    <head>
        <variable name="s"/>
        <variable name="opinion"/>
        <variable name="opiniao1_subject"/>
        <variable name="opiniao1_predicate"/>
        <variable name="opiniao2_predicate"/>
        <variable name="o"/>
    </head>
    <results>
        <result>
            <binding name="s">
                <uri>http://critica/#Pedro</uri>
            </binding>
            <binding name="opiniao1_predicate">
                <uri>http://critica/#achar</uri>
            </binding>
            <binding name="opiniao2_predicate">
                <uri>http://critica/#ser</uri>
            </binding>
            <binding name="opinion">
                <uri>http://critica/#dizer</uri>
            </binding>
            <binding name="opiniao1_subject">
                <uri>http://map/#Londres</uri>
            </binding>
            <binding name="o">
                <literal>Fabuloso</literal>
            </binding>
        </result>
    </results>
</sparql>
```

Figura 9 - Resultado da aplicacao da query para o reposito criado na aula anterior

7. Aplicação para explorar a “Linked Data”

```
import sys
import os.path
from myENDPOINT_access import f_ENDPOINT_access
from SPARQLWrapper import SPARQLWrapper, XML, N3, TURTLE, RDF, JSON, JSONLD

def chooseElement(arr, prompt):
    print(prompt)
    i = 1
    for f in arr:
        print(str(i) + ". " + f)
        i += 1

    j = -1
    while j <= 0 or j > len(arr):
        j = int(input(prompt))
    return arr[j - 1]

if __name__ == "__main__":
    if not os.path.exists("query.txt"):
        print("please create query.txt with valid SPARQL Query")

    f = open("query.txt", "r")
    query = f.read()
    f.close()

    print('default repository http://localhost:8280/rdf4j-server/repositories/repo-
con')
    repository = input('Introduza o url do repositório: ')
    if not repository:
        repository = "http://localhost:8280/rdf4j-server/repositories/repo-con"

    formats = [XML, N3, TURTLE, RDF, JSON, JSONLD]
    chosenFormat = chooseElement(formats, "Escolha o formato: ")

    responseFormat, resultSet = f_ENDPOINT_access( query, [chosenFormat],
repository )

    f = open("out.txt", "w")
    f.write(str(resultSet))
    f.close()

    print(resultSet)
```

Figura 10 - Codigo da Aplicacao exercicio 9

```
PREFIX ns4: <http://time/#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX ns1: <http://tocha/#>
PREFIX ns3: <http://critica/#>
SELECT ?s ?opinion ?opiniao1_subject ?opiniao1_predicate
?opiniao2_predicate ?o
WHERE {
  ?jogoOlimpico rdf:type ns1:JogosOlimpicos .
  ?opiniao2 rdf:subject ?jogoOlimpico .
  ?opiniao2 rdf:predicate ?opiniao2_predicate .
  ?opiniao2 rdf:object ?o .
  ?opiniao1 rdf:object ?opiniao2 .
  ?opiniao1 rdf:predicate ?opiniao1_predicate .
  ?opiniao1 rdf:subject ?opiniao1_subject .
  ?s ?opinion ?opiniao1
}
```

Figura 11 - Exemplo de query.txt

```
[['http://critica/#Pedro', 'http://critica/#dizer', 'http://map/#Londres',
'http://critica/#achar', 'http://critica/#ser', 'Fabuloso']]
```

Figura 12 - Resultado