CSE 488: Ontologies and the Semantic Web

Project Submission

Countries Ontology

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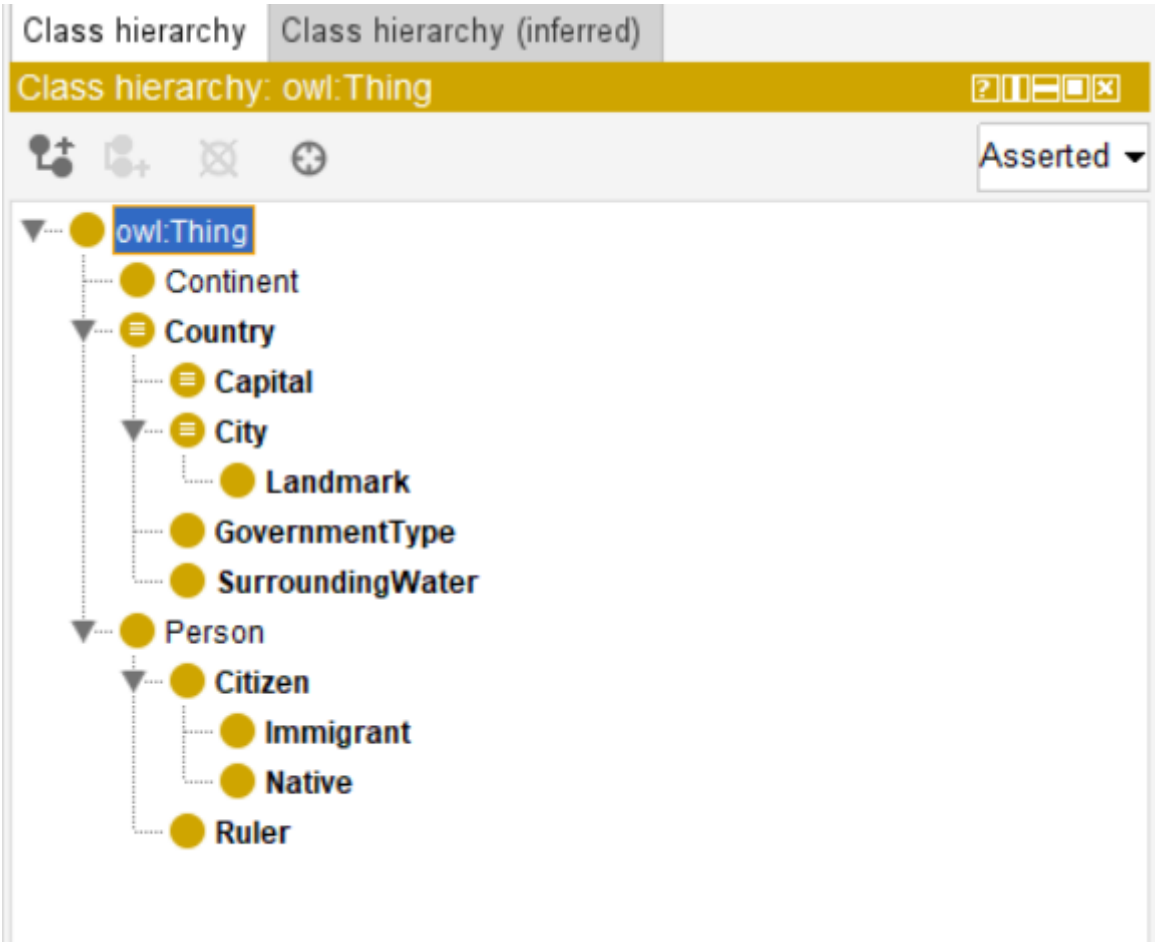
I. Ontology

The countries ontology is designed to represent information about countries, cities, landmarks, rulers, government types, immigrants, and surrounding waters. The ontology defines various object properties such as "hasCity," "hasGovernmentType," "hasImmigrants," "hasLandmark," "hasNativeResidents," "hasRuler," "isCapitalOf," "isInContinent," and "isSurroundedBy" to establish relationships between entities. It also includes data properties like "address," "hasYearBuilt," "rulertype," and "watertype" to capture specific information about landmarks, rulers, and surrounding waters. The ontology further defines classes such as "Capital," "City," "Continent," "Country," "GovernmentType," "Immigrant," "Landmark," "Native," "Person," and "Ruler" to classify different types of entities. By utilizing this ontology, you can organize and query data related to countries, their attributes, and relationships in a structured and semantic manner.

Classes



Object properties

- hasCity
- hasGovernmentType
- hasImmigrants
- hasLandmark
- hasNativeResidents
- hasRuler
- isCapitalOf
- isInContinent
- isSurroundedBy

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasCity

Domains (1)

- Country

Ranges (1)

- City

Usage (7)

- Australia **hasCity** Sydney
- China **hasCity** Shanghai
- Egypt **hasCity** Giza
- France **hasCity** Marseille
- Germany **hasCity** Hamburg
- India **hasCity** Mumbai
- United_States **hasCity** New_York

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasGovernmentType

Domains (1)

- Country

Ranges (1)

- GovernmentType

Usage (8)

- Country ≡ **hasGovernmentType** exactly 1 GovernmentType
- Australia **hasGovernmentType** Federal_Parliamentary_Constitutional_Monarchy
- China **hasGovernmentType** Communist_Party-led_State
- Egypt **hasGovernmentType** Republic
- France **hasGovernmentType** Semi-Presidential_Republic
- Germany **hasGovernmentType** Federal_Republic
- India **hasGovernmentType** Federal_Parliamentary_Democratic_Republic
- United_States **hasGovernmentType** Democracy

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasImmigrants

Domains (1)

- Country

Ranges (1)

- Immigrant

Usage (7)

- Australia **hasImmigrants** 300
- China **hasImmigrants** 450
- Egypt **hasImmigrants** 700
- France **hasImmigrants** 250
- Germany **hasImmigrants** 102
- India **hasImmigrants** 450
- United_States **hasImmigrants** 700

-
- x

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasLandmark

Domains (1)

- City

Ranges (1)

- Landmark

Usage (8)

- City ≡ **hasLandmark** max 3 Landmark
- Giza **hasLandmark** The_Great_Pyramids
- Hamburg **hasLandmark** Brandenburg_Gate
- Marseille **hasLandmark** Eiffel_Tower
- Mumbai **hasLandmark** Taj_Mahal
- New_York **hasLandmark** Statue_of_Liberty
- Shanghai **hasLandmark** Great_Wall_of_China
- Sydney **hasLandmark** Sydney_Opera_House

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasNativeResidents

Domains (1)

- Country

Ranges (1)

- Native

Usage (7)

- Australia **hasNativeResidents** 600000
- China **hasNativeResidents** 900000
- Egypt **hasNativeResidents** 5462700
- France **hasNativeResidents** 400000
- Germany **hasNativeResidents** 10000000
- India **hasNativeResidents** 670000
- United_States **hasNativeResidents** 5000000

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasRuler

Domains (1)

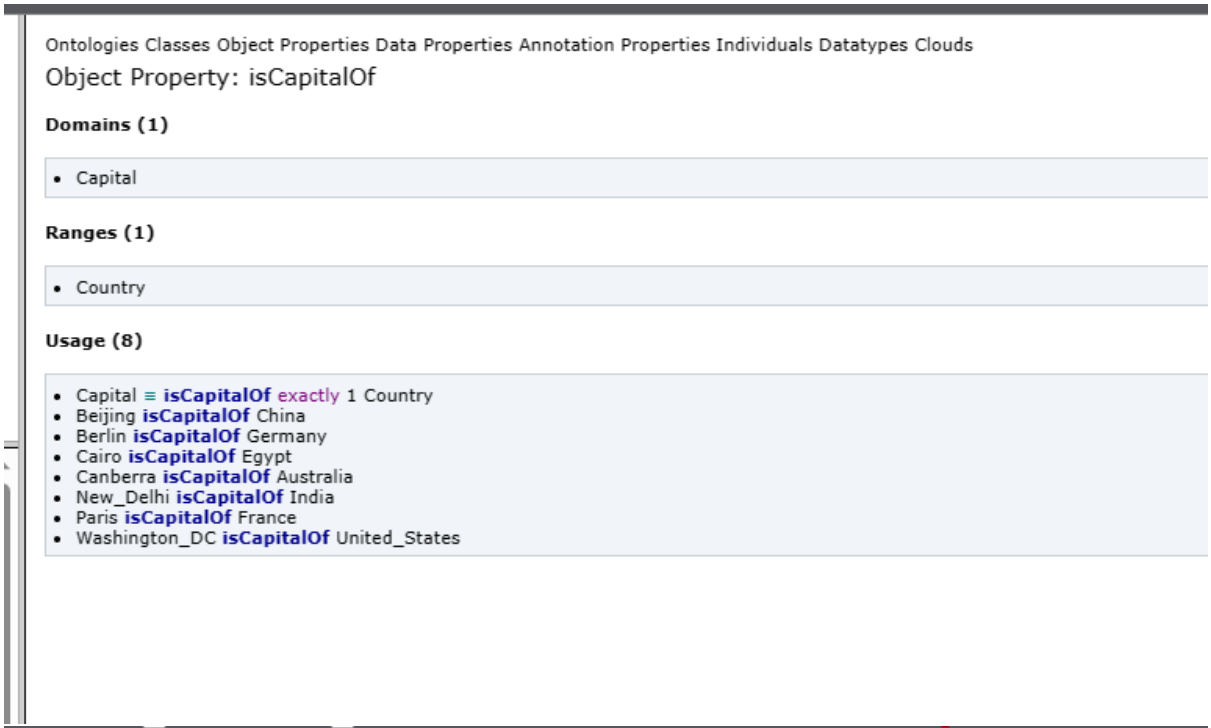
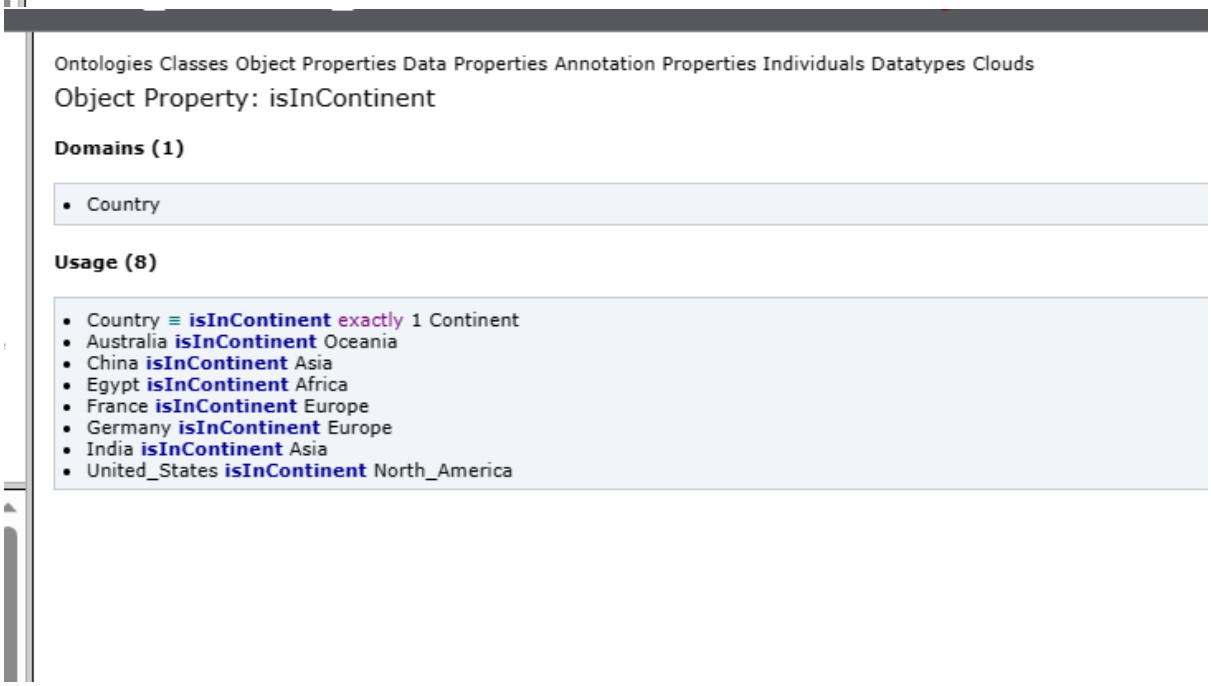
- Country

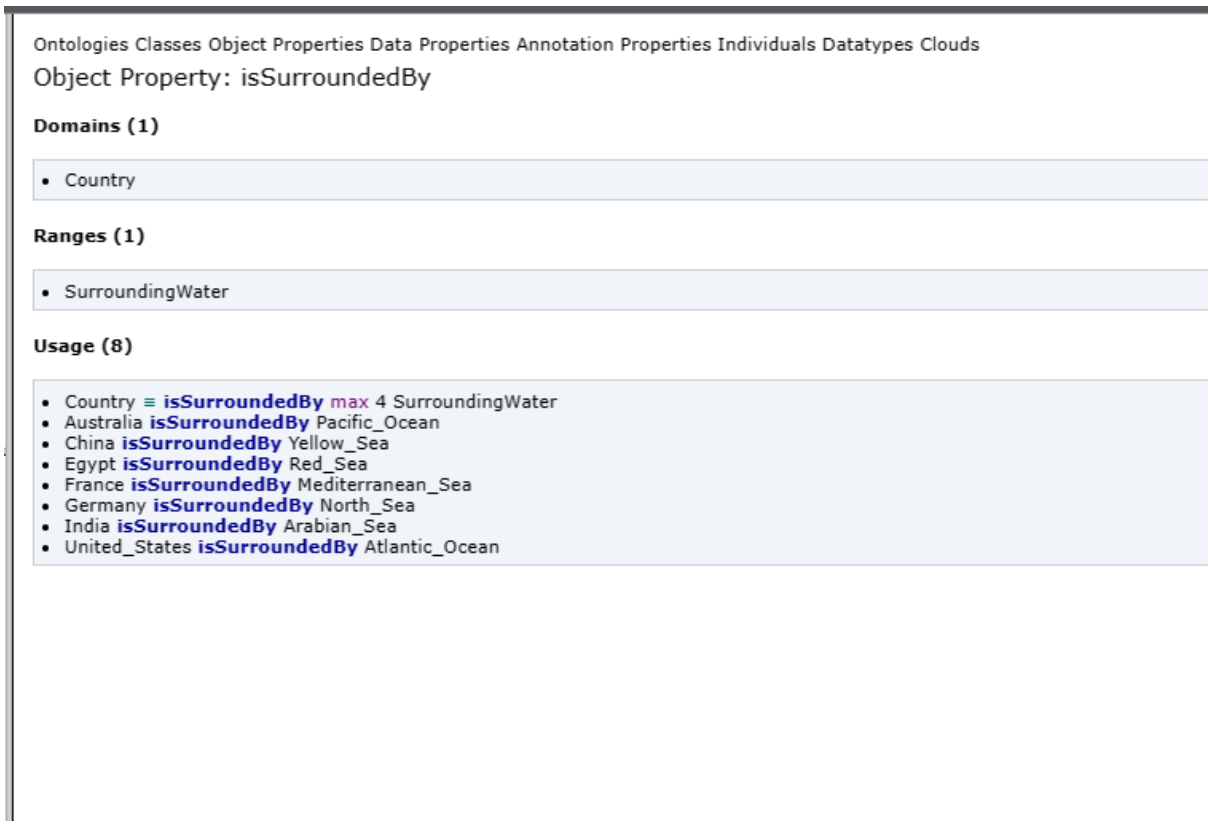
Ranges (1)

- Ruler

Usage (7)

- Country ≡ **hasRuler** exactly 1 Ruler
- Australia **hasRuler** Elizabeth_II
- China **hasRuler** Xi_Jinping
- Egypt **hasRuler** Abdel_Fattah_el-Sisi
- Germany **hasRuler** Angela_Merkel
- India **hasRuler** Ram_Nath_Kovind
- United_States **hasRuler** Joe_Biden

- 
Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds
Object Property: isCapitalOf
Domains (1)
Capital
Ranges (1)
Country
Usage (8)
Capital ≡ isCapitalOf exactly 1 Country
Beijing isCapitalOf China
Berlin isCapitalOf Germany
Cairo isCapitalOf Egypt
Canberra isCapitalOf Australia
New_Delhi isCapitalOf India
Paris isCapitalOf France
Washington_DC isCapitalOf United_States
- 
Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds
Object Property: isInContinent
Domains (1)
Country
Usage (8)
Country ≡ isInContinent exactly 1 Continent
Australia isInContinent Oceania
China isInContinent Asia
Egypt isInContinent Africa
France isInContinent Europe
Germany isInContinent Europe
India isInContinent Asia
United_States isInContinent North_America



constraints

each country has exactly 1 ruler
each city has max landmarks of 3
each country is in exactly 1 continent
each capital is capital of exactly 1 country
each country is surronded max by 4 water bodies
each country has exactly 1 gov type

Data properties

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Data Property: address

Domains (1)

- Landmark

Ranges (1)

- xsd:string

Usage (7)

- Brandenburg_Gate **address** "Brandenburger Tor
  Pariser Platz
  10117 Berlin
  Germany"(xsd:string)
- Eiffel_Tower **address** "Champ de Mars, 5 Avenue Anatole France, 75007 Paris, France"(xsd:string)
- Great_Wall_of_China **address** "Huairou, China"(xsd:string)
- Statue_of_Liberty **address** "Liberty Island, New York, NY 10004, United States" (xsd:string)
- Sydney_Opera_House **address** "Bennelong Point, Sydney NSW 2000, Australia" (xsd:string)
- Taj_Mahal **address** "Dharmapuri, Forest Colony
  Tajganj, Agra, Uttar Pradesh 282001"(xsd:string)
- The_Great_Pyramids **address** "Al Haram, Nazlet El-Semman
  Giza Governorate
  Egypt"(xsd:string)

OWL HTML inside

Data Property: hasYearBuilt

Domains (1)

- Landmark

Ranges (1)

- xsd:string

Usage (6)

- Brandenburg_Gate **hasYearBuilt** "1791 CE"(xsd:string)
- Eiffel_Tower **hasYearBuilt** "1889 CE"(xsd:string)
- Great_Wall_of_China **hasYearBuilt** "7th century BCE"(xsd:string)
- Sydney_Opera_House **hasYearBuilt** "1973 CE"(xsd:string)
- Taj_Mahal **hasYearBuilt** "1653 CE"(xsd:string)
- The_Great_Pyramids **hasYearBuilt** "2560 BCE"(xsd:string)

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Data Property: rulertype

Domains (1)

- Ruler

Ranges (1)

- xsd:string

Usage (6)

- Abdel_Fattah_el-Sisi **rulertype** "President"(xsd:string)
- Angela_Merkel **rulertype** "Chancellor"(xsd:string)
- Emmanuel_Macron **rulertype** "President"(xsd:string)
- Joe_Biden **rulertype** "President"(xsd:string)
- Ram_Nath_Kovind **rulertype** "President"(xsd:string)
- Xi_Jinping **rulertype** "President"(xsd:string)

OWL HTML inside

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Data Property: watertype

Domains (1)

- SurroundingWater

Ranges (1)

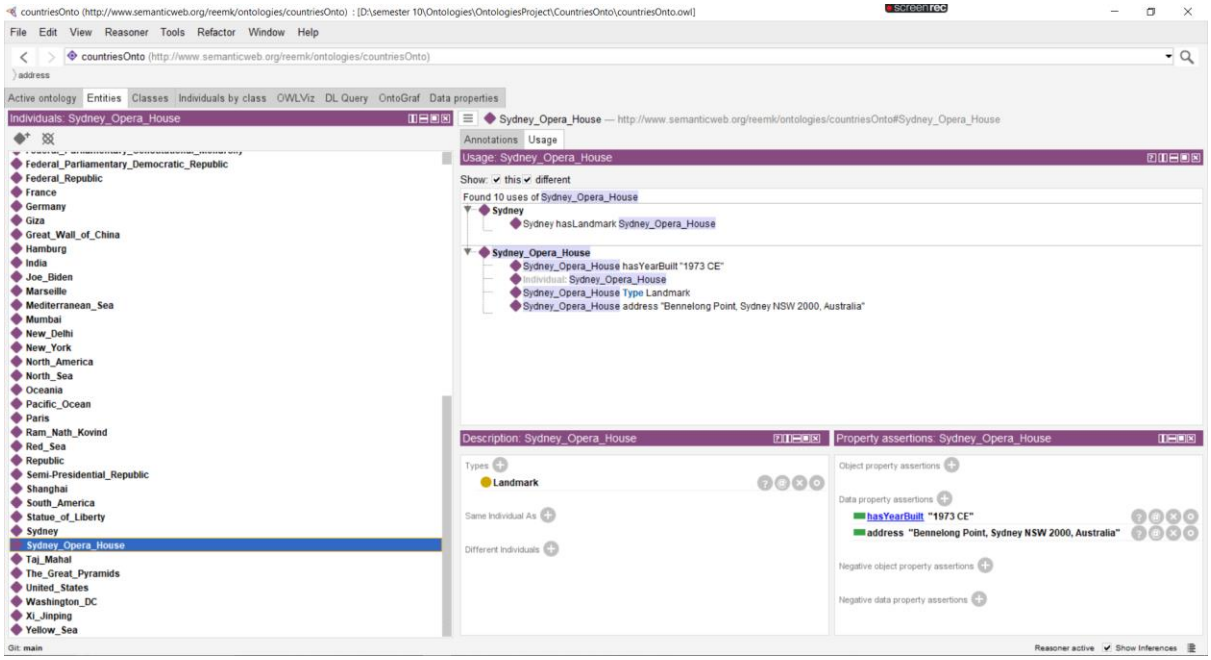
- xsd:string

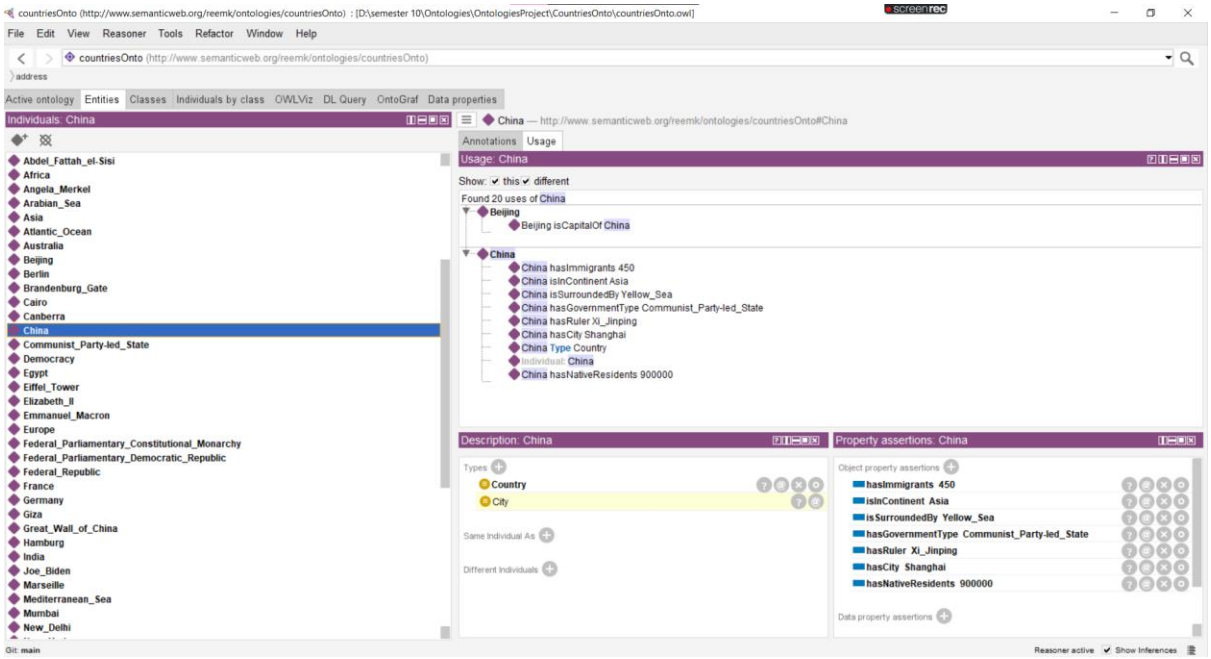
Usage (7)

- Arabian_Sea **watertype** "sea"(xsd:string)
- Atlantic_Ocean **watertype** "ocean"(xsd:string)
- Mediterranean_Sea **watertype** "sea"(xsd:string)
- North_Sea **watertype** "sea"(xsd:string)
- Pacific_Ocean **watertype** "ocean"(xsd:string)
- Red_Sea **watertype** "sea"(xsd:string)
- Yellow_Sea **watertype** "sea"(xsd:string)

OWL HTML inside

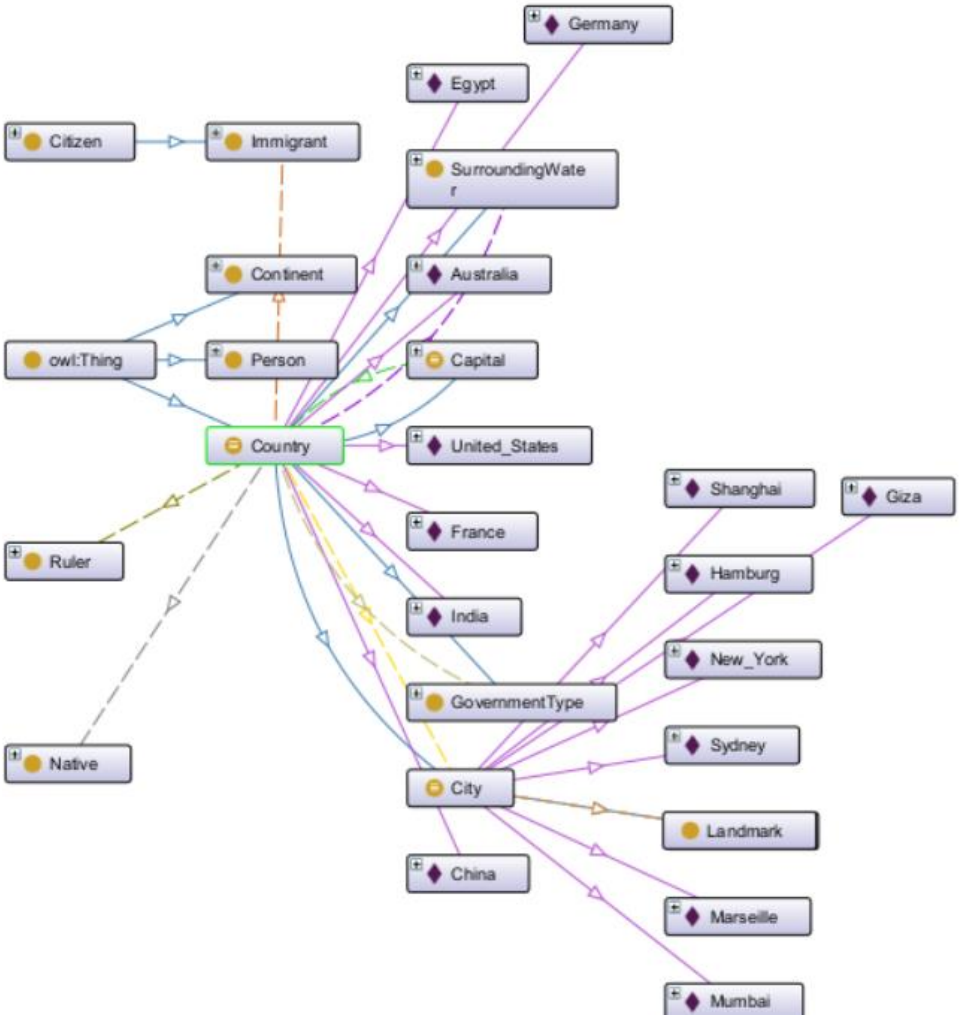
Individuals



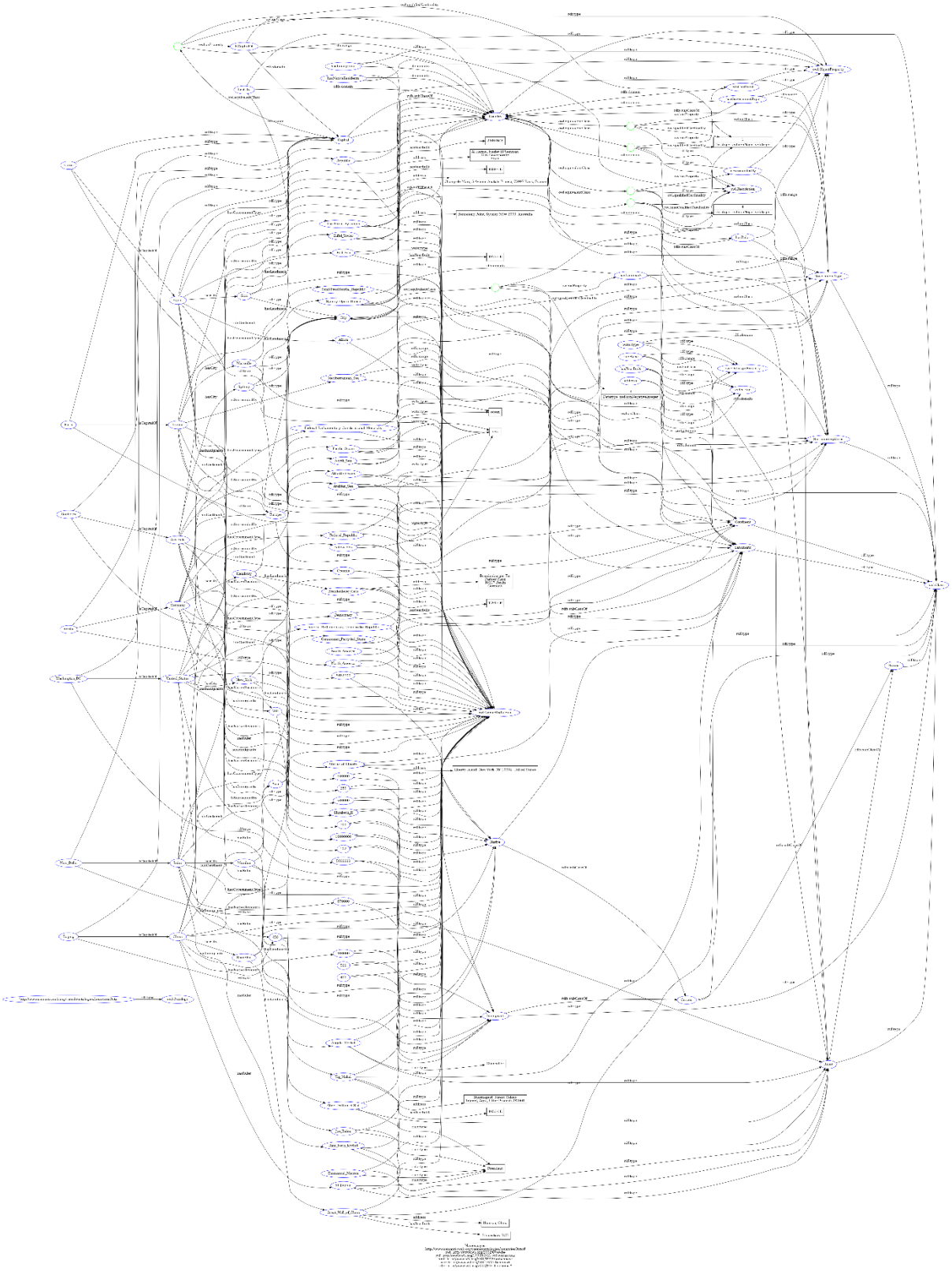


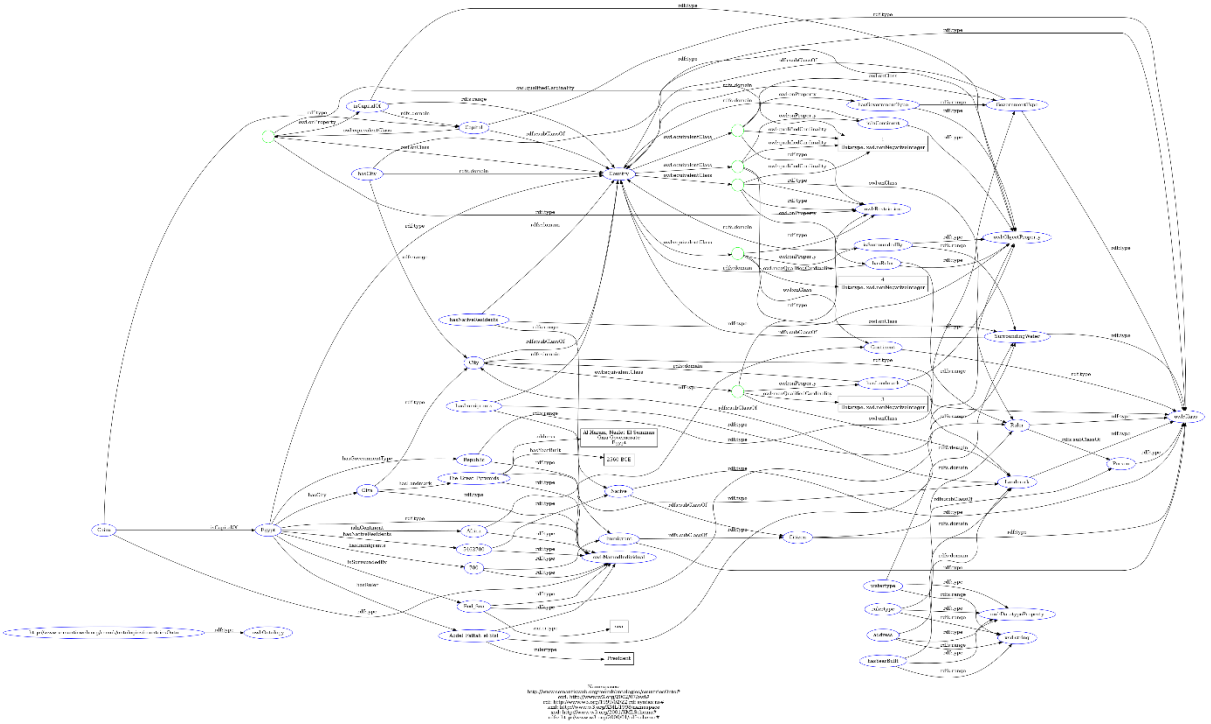
Visualization

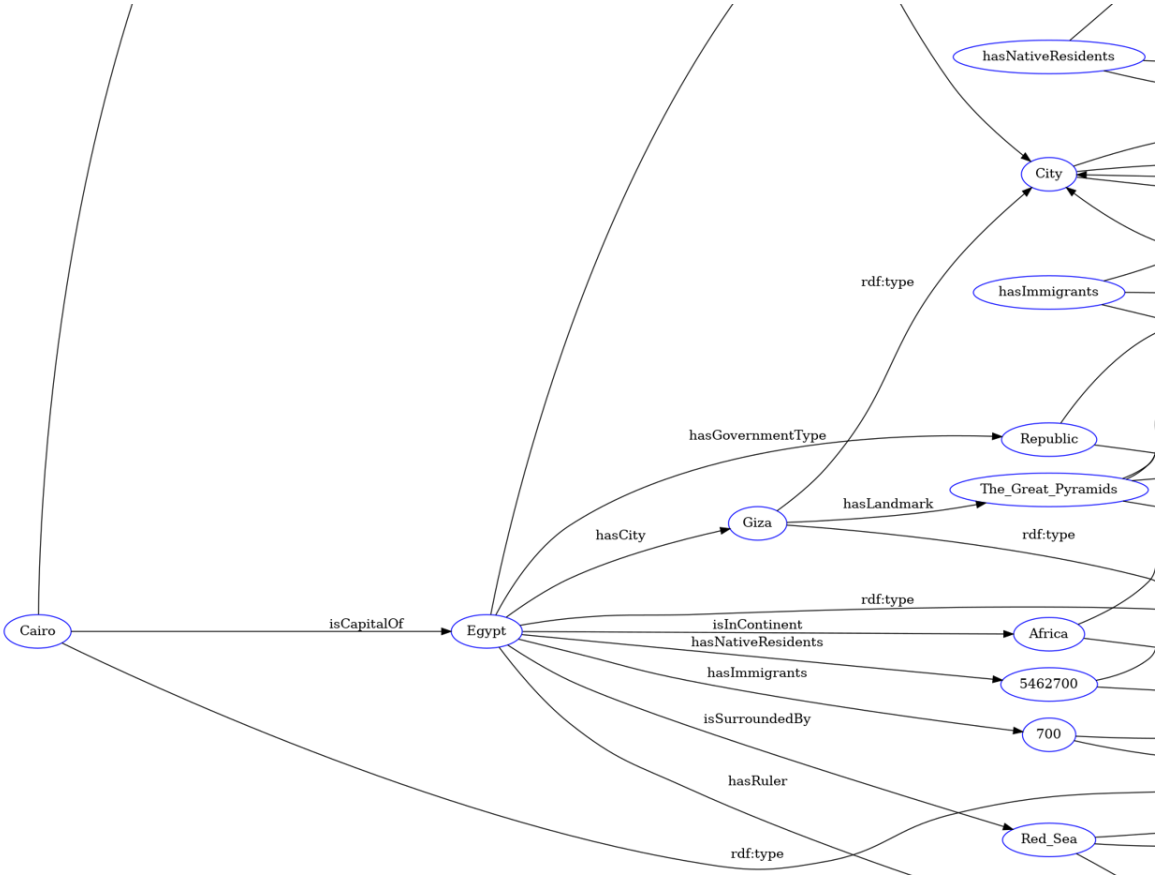
Ontograph



RDF graph






hasNativeResidents
City
rdf:type
hasImmigrants
hasGovernmentType
Republic
The_Great_Pyramids
hasLandmark
hasCity
Giza
rdf:type
rdf:type
Cairo
isCapitalOf
Egypt
isInContinent
Africa
hasNativeResidents
hasImmigrants
5462700
isSurroundedBy
700
hasRuler
Red_Sea
rdf:type

II. PROTÉGÉ SPARQL

➢ Query 1:

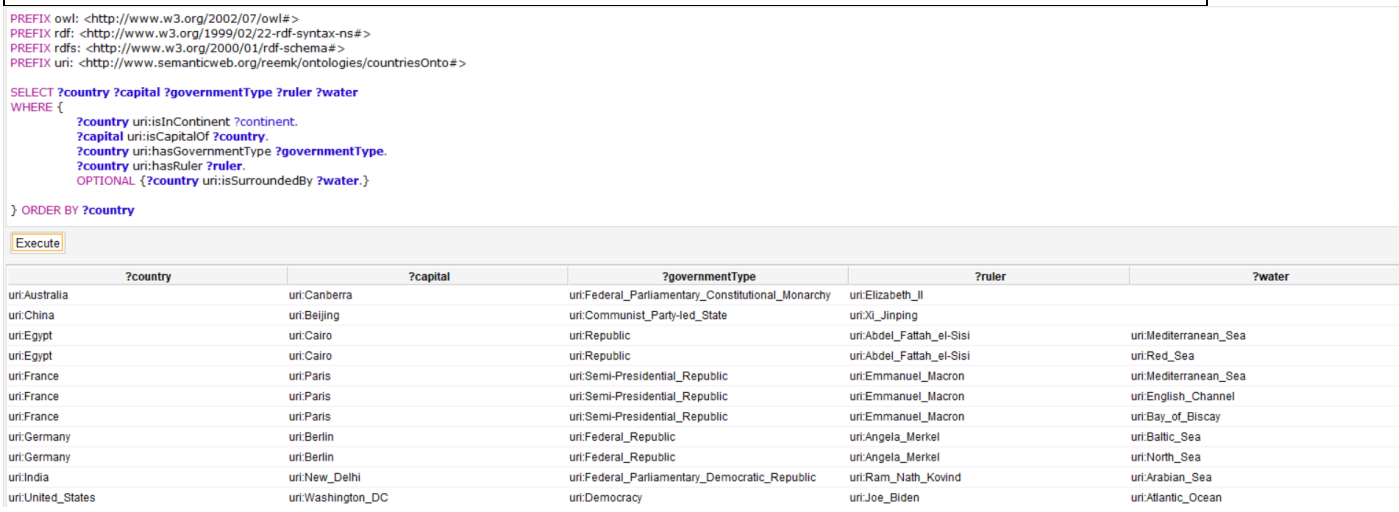
List all countries name, their capitals, government type, current ruler name, and OPTIONAL the surrounding water

- **In Protégé SPARQL**

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country ?capital ?governmentType ?ruler ?water
WHERE {
        ?country uri:isInContinent ?continent.
        ?capital uri:isCapitalOf ?country.
        ?country uri:hasGovernmentType ?governmentType.
        ?country uri:hasRuler ?ruler.
        OPTIONAL {?country uri:isSurroundedBy ?water.}

} ORDER BY ?country
```



```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country ?capital ?governmentType ?ruler ?water
WHERE {
        ?country uri:isInContinent ?continent.
        ?capital uri:isCapitalOf ?country.
        ?country uri:hasGovernmentType ?governmentType.
        ?country uri:hasRuler ?ruler.
        OPTIONAL {?country uri:isSurroundedBy ?water.}

} ORDER BY ?country
```

Execute

?country	?capital	?governmentType	?ruler	?water
uri:Australia	uri:Canberra	uri:Federal_Parliamentary_Constitutional_Monarchy	uri:Elizabeth_II	
uri:China	uri:Beijing	uri:Communist_Party-led_State	uri:Xi_Jinping	
uri:Egypt	uri:Cairo	uri:Republic	uri:Abdel_Fattah_el-Sisi	uri:Mediterranean_Sea
uri:Egypt	uri:Cairo	uri:Republic	uri:Abdel_Fattah_el-Sisi	uri:Red_Sea
uri:France	uri:Paris	uri:Semi-Presidential_Republic	uri:Emmanuel_Macron	uri:Mediterranean_Sea
uri:France	uri:Paris	uri:Semi-Presidential_Republic	uri:Emmanuel_Macron	uri:English_Channel
uri:France	uri:Paris	uri:Semi-Presidential_Republic	uri:Emmanuel_Macron	uri:Bay_of_Biscay
uri:Germany	uri:Berlin	uri:Federal_Republic	uri:Angela_Merkel	uri:Baltic_Sea
uri:Germany	uri:Berlin	uri:Federal_Republic	uri:Angela_Merkel	uri:North_Sea
uri:India	uri:New_Delhi	uri:Federal_Parliamentary_Democratic_Republic	uri:Ram_Nath_Kovind	uri:Arabian_Sea
uri:United_States	uri:Washington_DC	uri:Democracy	uri:Joe_Biden	uri:Atlantic_Ocean

➢ Query 2:

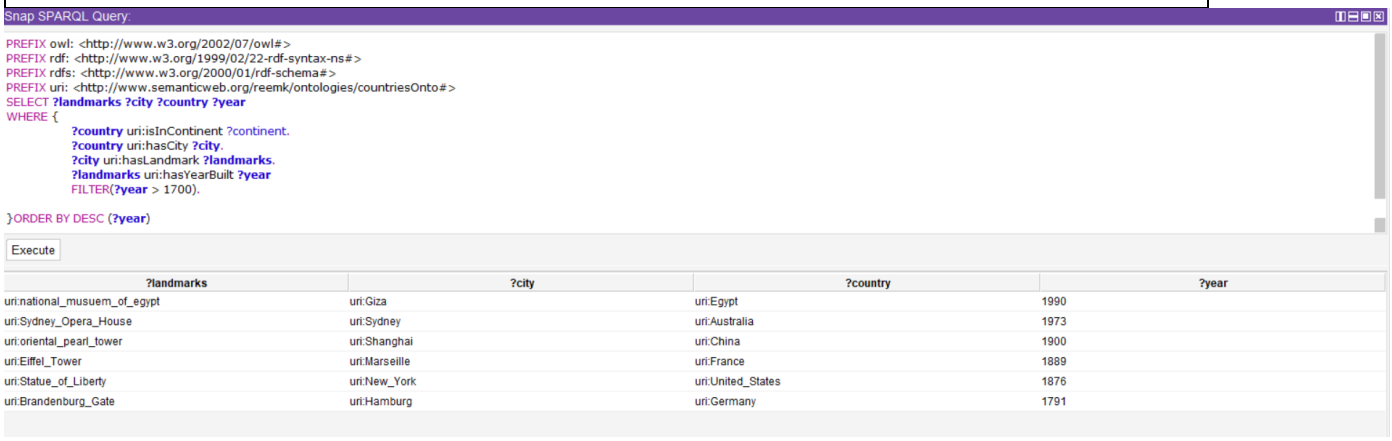
- **In Protégé SPARQL**

Find the landmarks that were built at year > 1700 and show which cities and countries they belong to ordered by the year build in descending order.

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>
SELECT ?landmarks ?city ?country ?year
WHERE {
        ?country uri:isInContinent ?continent.
        ?country uri:hasCity ?city.
        ?city uri:hasLandmark ?landmarks.
```

```
        ?landmarks uri:hasYearBuilt ?year
        FILTER(?year > 1700).

}ORDER BY DESC (?year)
```



➢ Query 3:

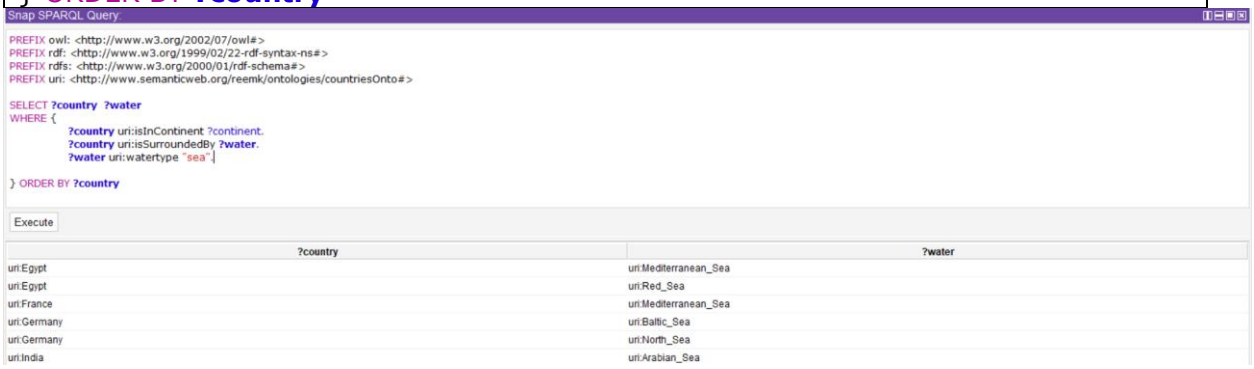
List all counties name and their surrounding water that has surrounding water that has type sea

- **In Protégé SPARQL**

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country  ?water
WHERE {
        ?country uri:isInContinent ?continent.
        ?country uri:isSurroundedBy ?water.
        ?water uri:watertype "sea".

} ORDER BY ?country
```



➢ Query 4:

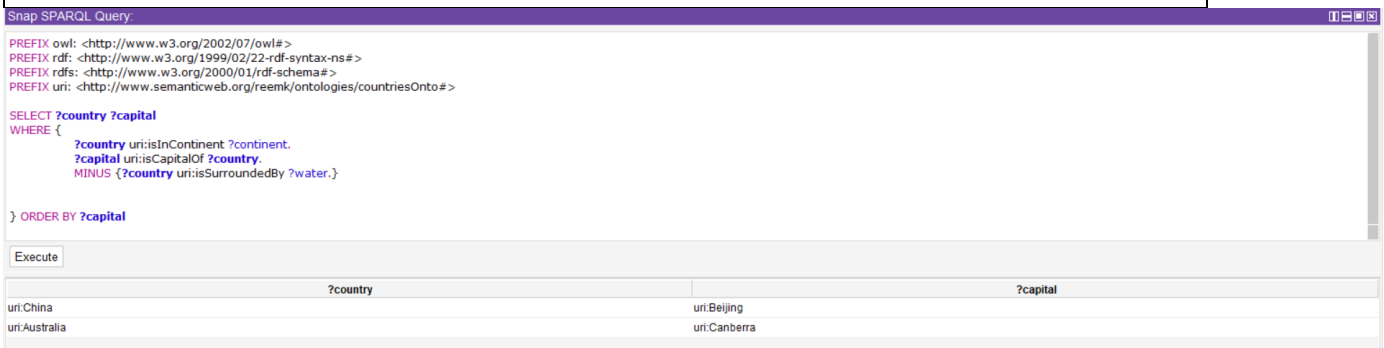
List all countries and their capitals that don't have surrounding water ordered by capital name.

- **In Protégé SPARQL**

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country ?capital
WHERE {
        ?country uri:isInContinent ?continent.
        ?capital uri:isCapitalOf ?country.
        MINUS {?country uri:isSurroundedBy ?water.}


} ORDER BY ?capital
```



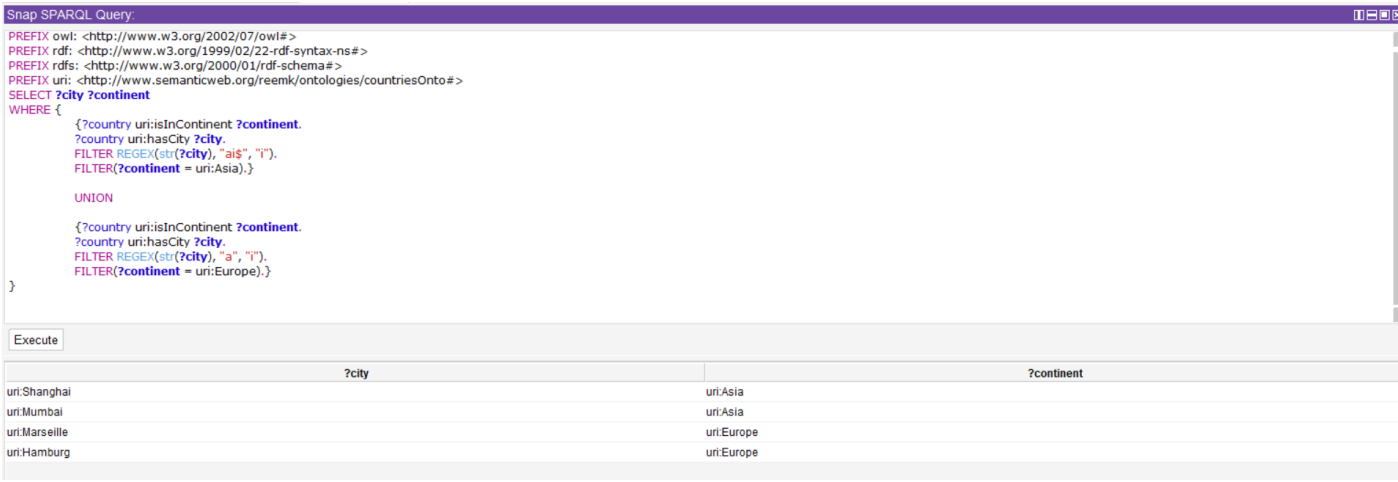
- Query 5:

List cities that have “a” in their name and exist in Europe or the cities that ends with “ai” and exist in Asia (FILTER REGEX)

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>
SELECT ?city ?continent
WHERE {
        {?country uri:isInContinent ?continent.
        ?country uri:hasCity ?city.
        FILTER REGEX(str(?city), "ai$", "i").
        FILTER(?continent = uri:Asia).}

        UNION

        {?country uri:isInContinent ?continent.
        ?country uri:hasCity ?city.
        FILTER REGEX(str(?city), "a", "i").
        FILTER(?continent = uri:Europe).}
}
```



➢ Query 6:

List countries, and their ruler that has government type democracy or republic or ruler is queen.

- **In Protégé SPARQL**

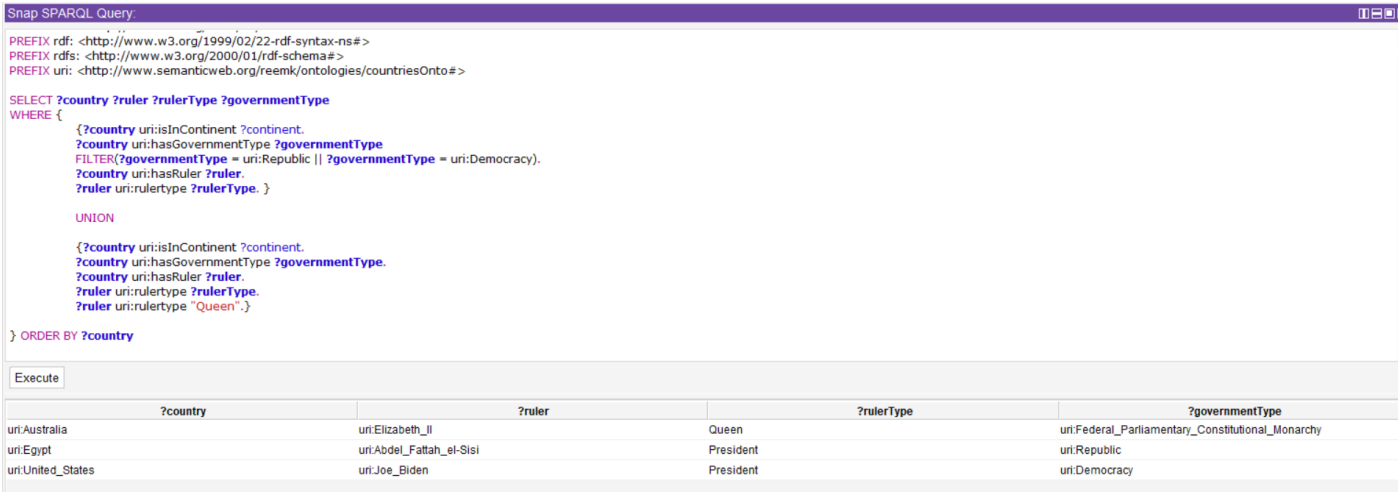
```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country ?ruler ?rulerType ?governmentType
WHERE {
        {?country uri:isInContinent ?continent.
        ?country uri:hasGovernmentType ?governmentType
        FILTER(?governmentType = uri:Republic || ?governmentType =
uri:Democracy).
        ?country uri:hasRuler ?ruler.
        ?ruler uri:rulertype ?rulerType. }

        UNION

        {?country uri:isInContinent ?continent.
        ?country uri:hasGovernmentType ?governmentType.
        ?country uri:hasRuler ?ruler.
        ?ruler uri:rulertype ?rulerType.
        ?ruler uri:rulertype "Queen".}

} ORDER BY ?country
```



➢ Query 7:

List all cities and their landmarks that are in Europe or North America ordered by the city in ascending order

- **In Protégé SPARQL**

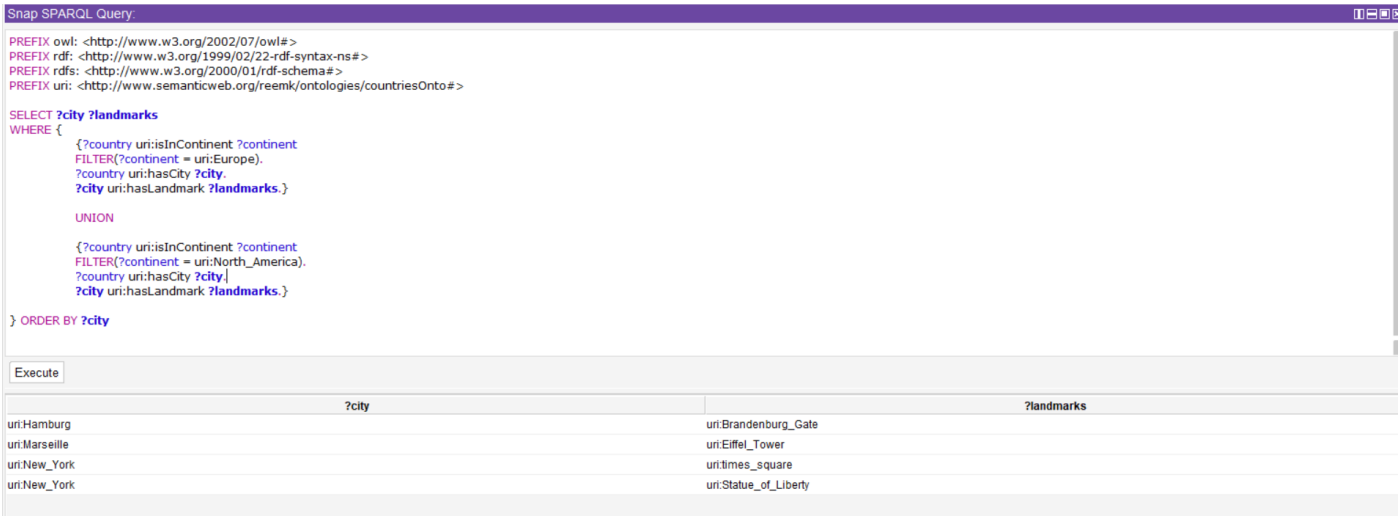
```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?city ?landmarks
WHERE {
        {?country uri:isInContinent ?continent
        FILTER(?continent = uri:Europe).
        ?country uri:hasCity ?city.
        ?city uri:hasLandmark ?landmarks.}

        UNION

        {?country uri:isInContinent ?continent
        FILTER(?continent = uri:North_America).
        ?country uri:hasCity ?city.
        ?city uri:hasLandmark ?landmarks.}

} ORDER BY ?city
```



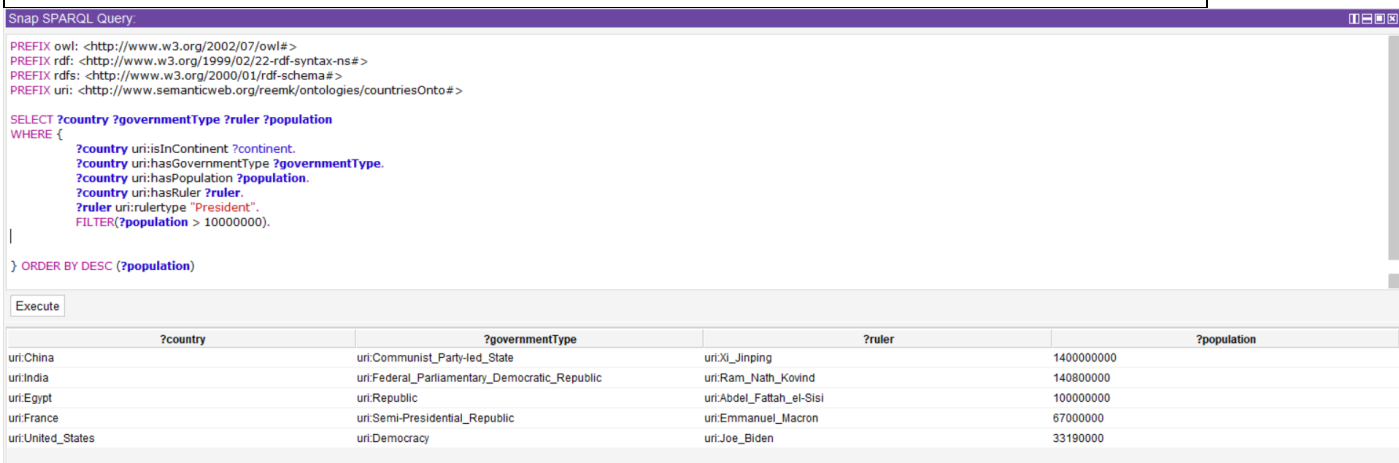
➢ Query 8:

List the countries, government type ,population, and their ruler that has ruler type president and population >10 million and order countries in descending order according to their population

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country ?governmentType ?ruler ?population
WHERE {
        ?country uri:isInContinent ?continent.
        ?country uri:hasGovernmentType ?governmentType.
        ?country uri:hasPopulation ?population.
        ?country uri:hasRuler ?ruler.
        ?ruler uri:rulertype "President".
        FILTER(?population > 10000000).

} ORDER BY DESC (?population)
```



➢ Query 9:

Which countries has how many landmarks.

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country (COUNT(?landmarks) AS ?landmarks_count)
WHERE {
        ?country uri:isInContinent ?continent.
        ?country uri:hasCity ?city.
        ?city uri:hasLandmark ?landmarks.

} GROUP BY ?country
ORDER BY DESC (?landmarks_count)
```

Snap SPARQL Query:

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX uri: <http://www.semanticweb.org/reemk/ontologies/countriesOnto#>

SELECT ?country (COUNT(?landmarks) AS ?landmarks_count)
WHERE {
        ?country uri:isInContinent ?continent.
        ?country uri:hasCity ?city.
        ?city uri:hasLandmark ?landmarks.

} GROUP BY ?country
ORDER BY DESC (?landmarks_count)
```

Execute

?country	?landmarks_count
uri:Egypt	3
uri:United_States	2
uri:China	2
uri:Australia	1
uri:India	1
uri:France	1
uri:Germany	1

III. JENA QUERIES

➢ Query 1:

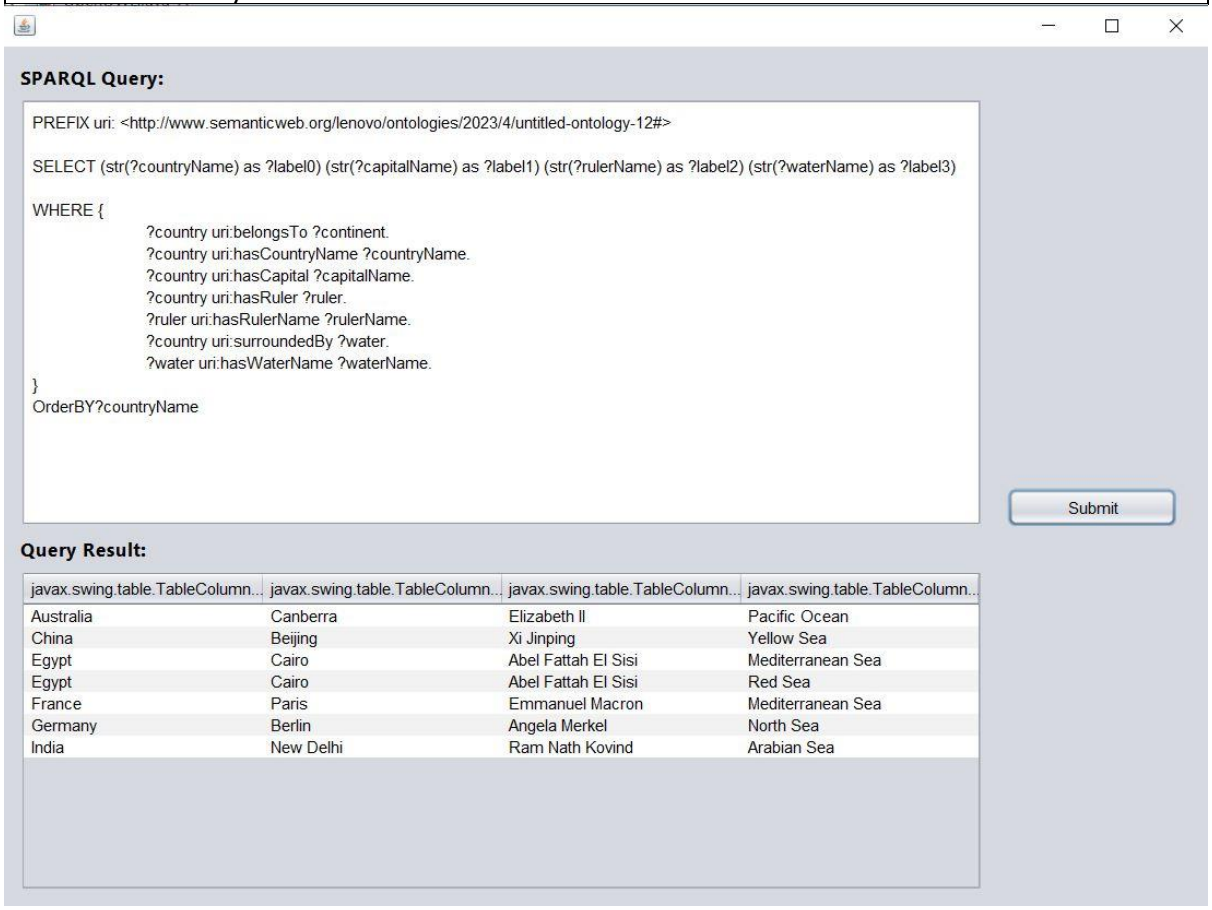
List all countries' name, their capitals, current ruler name, and the surrounding water.

- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>

SELECT (str(?countryName) as ?label0) (str(?capitalName) as ?label1) (str(?rulerName) as ?label2) (str(?waterName) as ?label3)

WHERE {
        ?country uri:belongsTo ?continent.
        ?country uri:hasCountryName ?countryName.
        ?country uri:hasCapital ?capitalName.
        ?country uri:hasRuler ?ruler.
        ?ruler uri:hasRulerName ?rulerName.
        ?country uri:surroundedBy ?water.
        ?water uri:hasWaterName ?waterName.
}
OrderBY?countryName
```



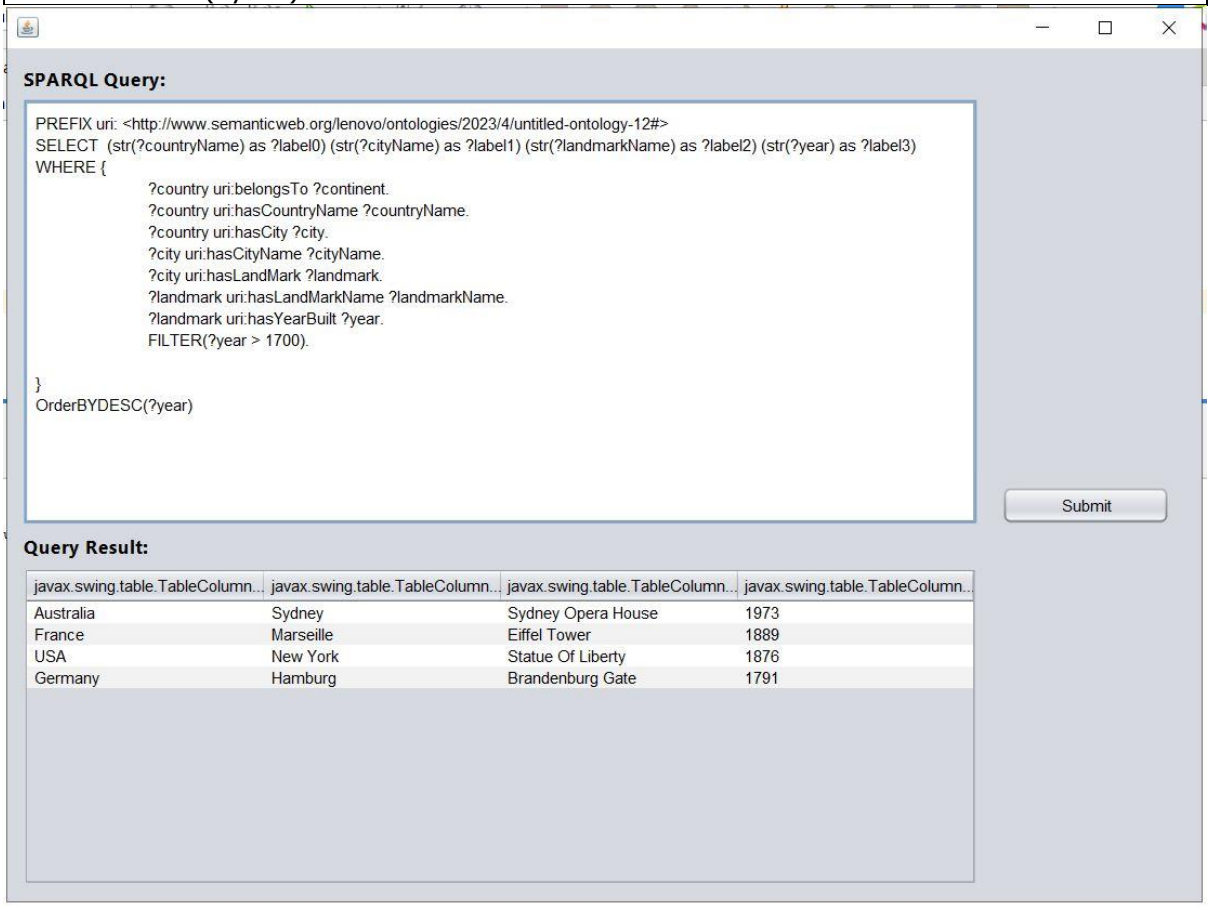
➢ Query 2:

- **In Jena SPARQL**

Find the landmarks that were built at year > 1700 and show which cities and countries they belong to ordered by the year build in descending order.

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>
SELECT  (str(?countryName) as ?label0) (str(?cityName) as ?label1) (str(?landmarkName) as ?label2) (str(?year) as ?label3)
WHERE {
        ?country uri:belongsTo ?continent.
        ?country uri:hasCountryName ?countryName.
        ?country uri:hasCity ?city.
        ?city uri:hasCityName ?cityName.
        ?city uri:hasLandMark ?landmark.
        ?landmark uri:hasLandMarkName ?landmarkName.
        ?landmark uri:hasYearBuilt ?year.
        FILTER(?year > 1700).

}
OrderBYDESC(?year)
```



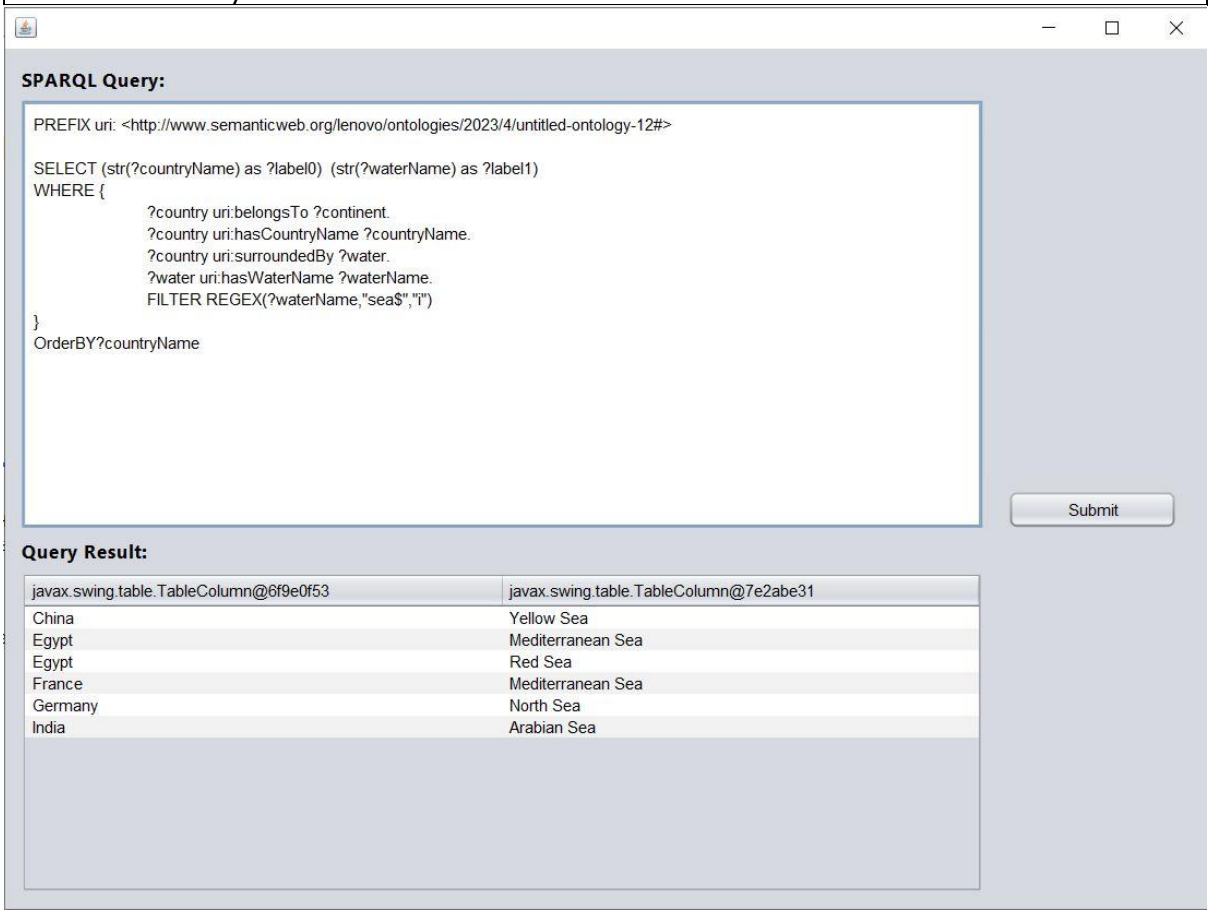
➢ Query 3:

List all counties name and their surrounding water that has surrounding water that has type sea

- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>

SELECT (str(?countryName) as ?label0)  (str(?waterName) as ?label1)
WHERE {
        ?country uri:belongsTo ?continent.
        ?country uri:hasCountryName ?countryName.
        ?country uri:surroundedBy ?water.
        ?water uri:hasWaterName ?waterName.
        FILTER REGEX(?waterName,"sea$","i")
}
OrderBY?countryName
```

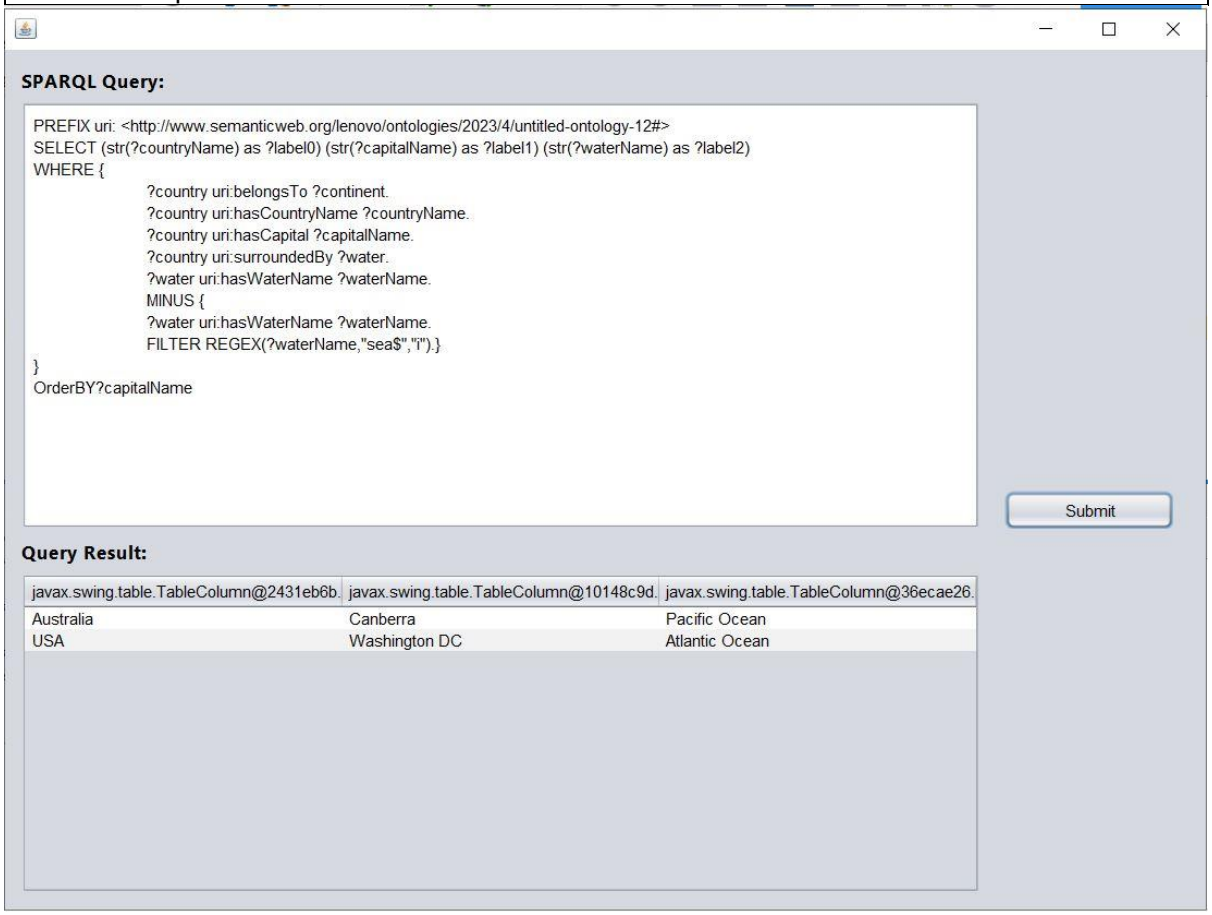


➢ Query 4:

List all countries and their capitals that don't have surrounding water type sea ordered by capital name and show the water name.

- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>
SELECT (str(?countryName) as ?label0) (str(?capitalName) as ?label1) (str(?waterName) as ?label2)
WHERE {
        ?country uri:belongsTo ?continent.
        ?country uri:hasCountryName ?countryName.
        ?country uri:hasCapital ?capitalName.
        ?country uri:surroundedBy ?water.
        ?water uri:hasWaterName ?waterName.
        MINUS {
        ?water uri:hasWaterName ?waterName.
        FILTER REGEX(?waterName,"sea$","i").}
}
OrderBY?capitalName
```



➢ Query 5:

List cities that have "a" in their name and exist in Europe or the cities that ends with "ai" and exist in Asia (FILTER REGEX)

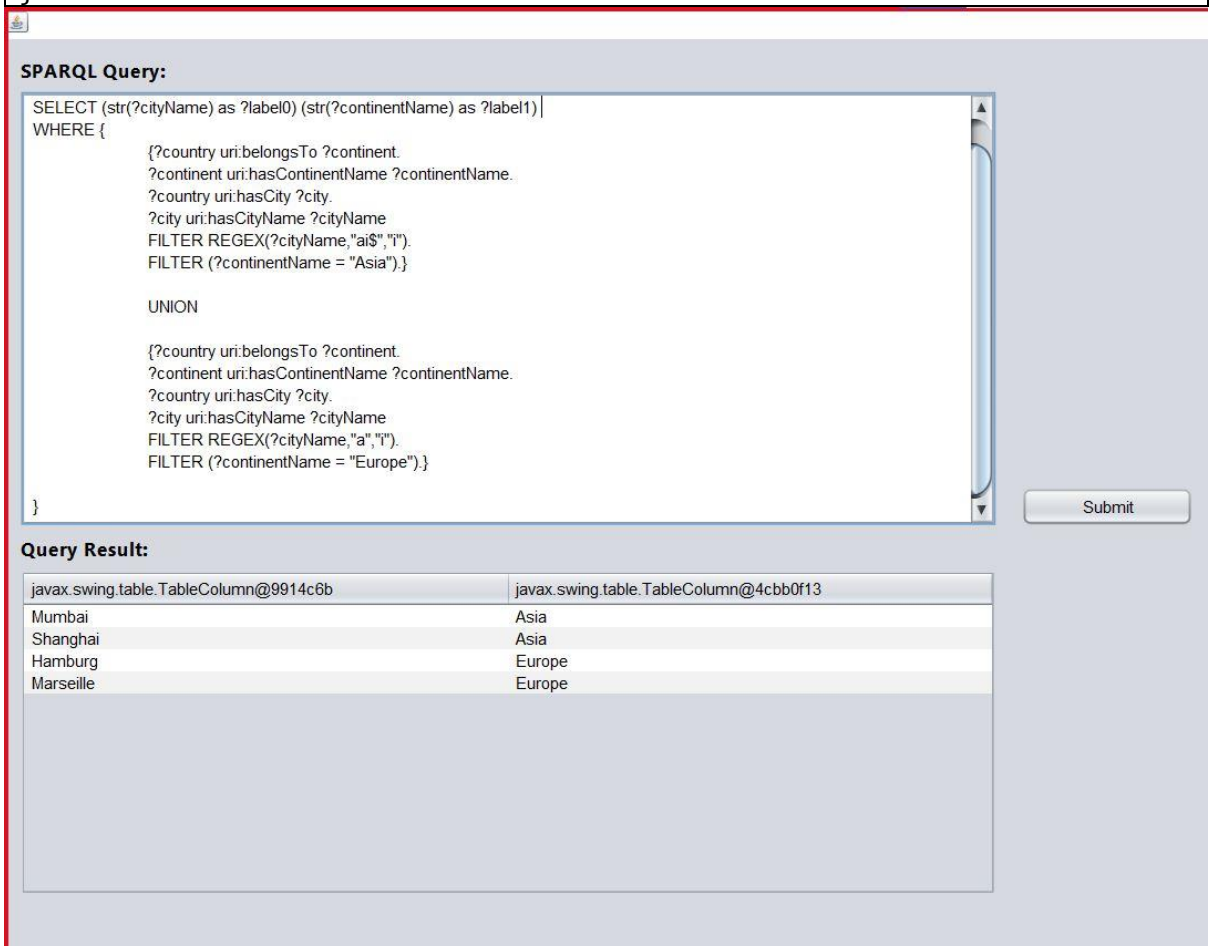
- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>
SELECT (str(?cityName) as ?label0) (str(?continentName) as ?label1)
WHERE {
        {?country uri:belongsTo ?continent.
        ?continent uri:hasContinentName ?continentName.
        ?country uri:hasCity ?city.
        ?city uri:hasCityName ?cityName
        FILTER REGEX(?cityName,"ai$","i").
        FILTER (?continentName = "Asia").}

        UNION

        {?country uri:belongsTo ?continent.
        ?continent uri:hasContinentName ?continentName.
        ?country uri:hasCity ?city.
        ?city uri:hasCityName ?cityName
        FILTER REGEX(?cityName,"a","i").
        FILTER (?continentName = "Europe").}

}
```

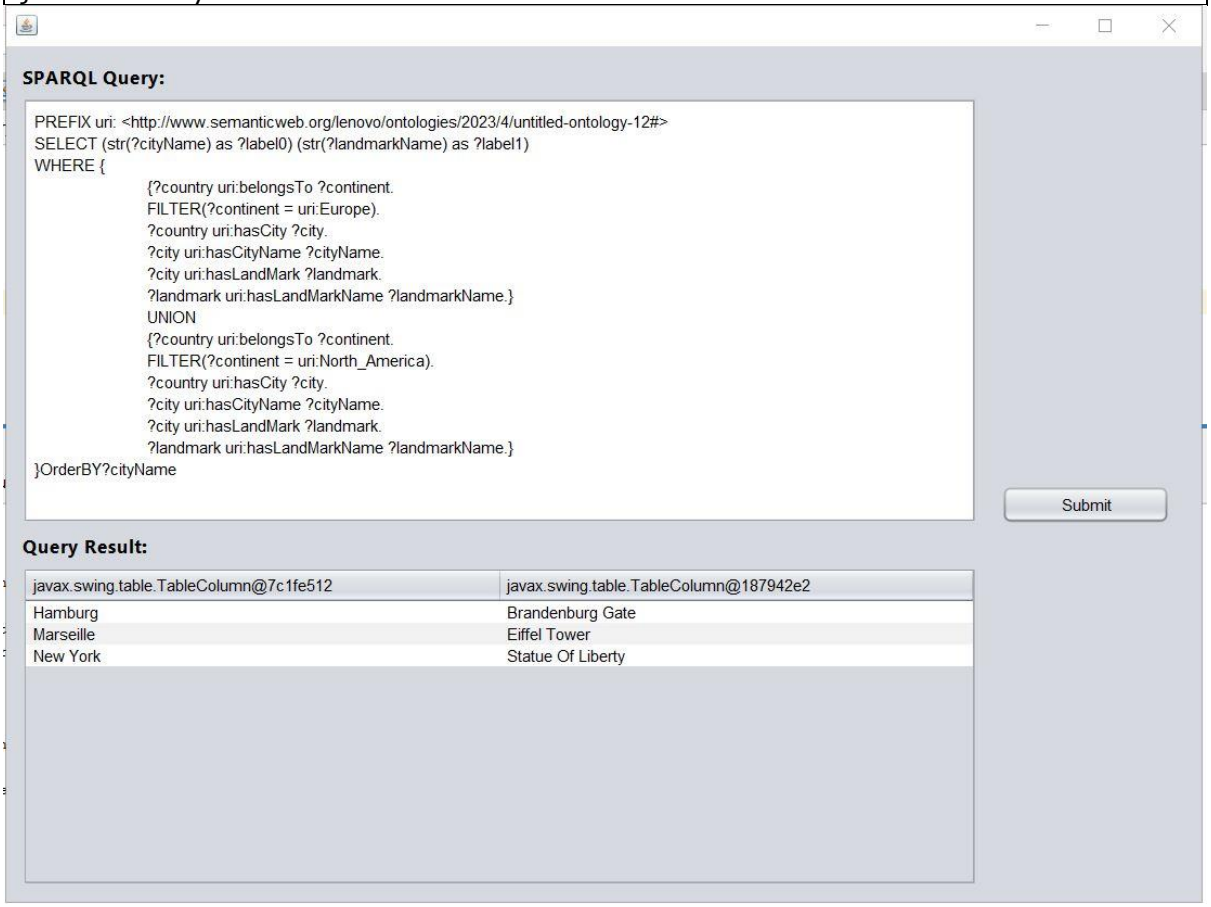


➢ Query 6:

List all cities and their landmarks that are in Europe or North America ordered by the city in ascending order

- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>
SELECT (str(?cityName) as ?label0) (str(?landmarkName) as ?label1)
WHERE {
        {?country uri:belongsTo ?continent.
        FILTER(?continent = uri:Europe).
        ?country uri:hasCity ?city.
        ?city uri:hasCityName ?cityName.
        ?city uri:hasLandMark ?landmark.
        ?landmark uri:hasLandMarkName ?landmarkName.}
        UNION
        {?country uri:belongsTo ?continent.
        FILTER(?continent = uri:North_America).
        ?country uri:hasCity ?city.
        ?city uri:hasCityName ?cityName.
        ?city uri:hasLandMark ?landmark.
        ?landmark uri:hasLandMarkName ?landmarkName.}
}OrderBY?cityName
```



➢ Query 7:

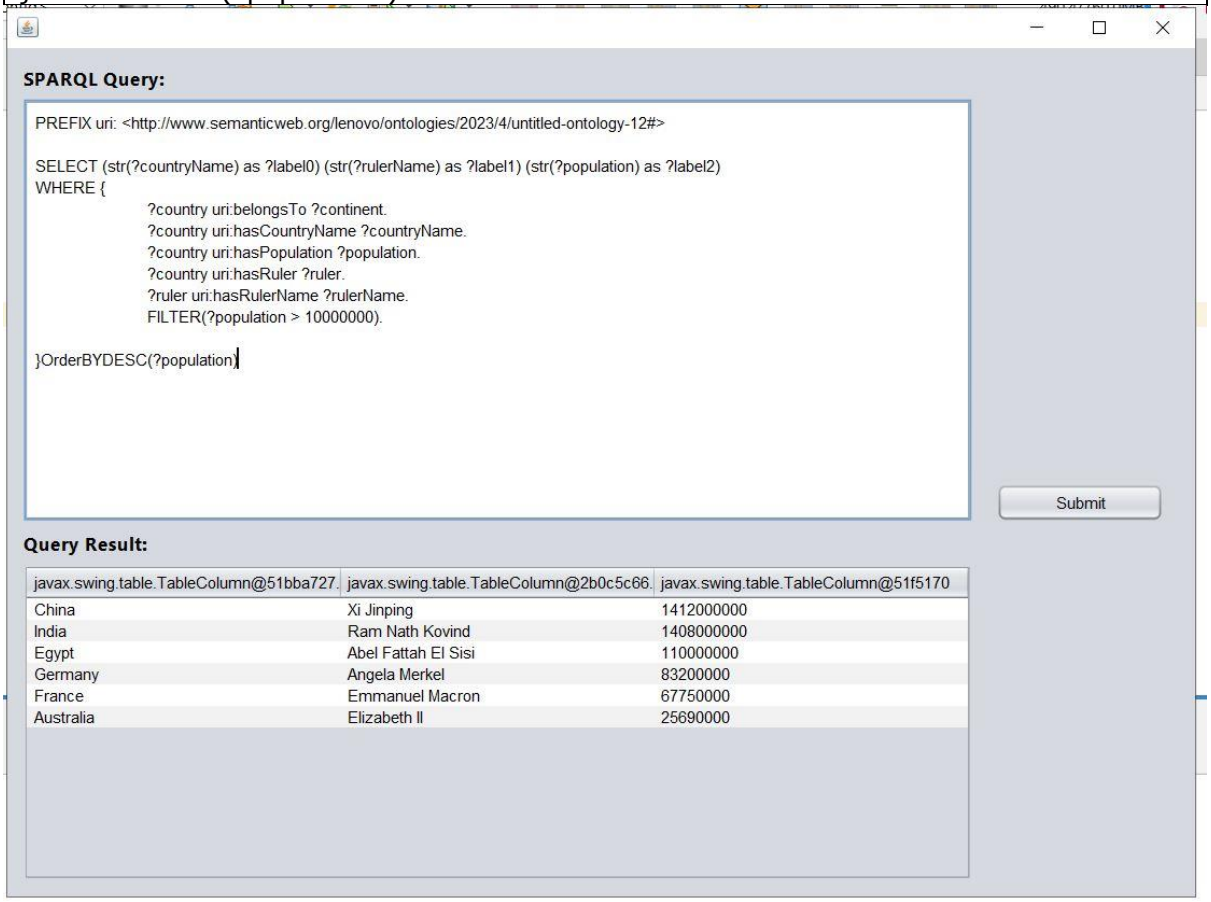
List the countries, population, and their ruler and population >10 million and order countries in descending order according to their population.

- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>

SELECT (str(?countryName) as ?label0) (str(?rulerName) as ?label1) (str(?population) as ?label2)
WHERE {
        ?country uri:belongsTo ?continent.
        ?country uri:hasCountryName ?countryName.
        ?country uri:hasPopulation ?population.
        ?country uri:hasRuler ?ruler.
        ?ruler uri:hasRulerName ?rulerName.
        FILTER(?population > 10000000).

}OrderBYDESC(?population)
```



➢ Query 8:

Which countries has how many landmarks ordered in descending order of count.

- **In Jena SPARQL**

```
PREFIX uri: <http://www.semanticweb.org/lenovo/ontologies/2023/4/untitled-ontology-12#>

SELECT (str(?countryName) as ?label0) (str(COUNT(?landmarkName)) as ?label1)
WHERE {
        ?country uri:belongsTo ?continent.
        ?country uri:hasCountryName ?countryName.
        ?country uri:hasCity ?city.
        ?city uri:hasLandMark ?landmark.
        ?landmark uri:hasLandMarkName ?landmarkName.

}GROUP BY ?countryName
OrderBYDESC(?label1)
```