2024

Milestone I: A Design and Implementation for Movies Ontology

CSE488: ONTOLOGIES AND THE SEMANTIC WEB

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Part I: Modeling the Ontology

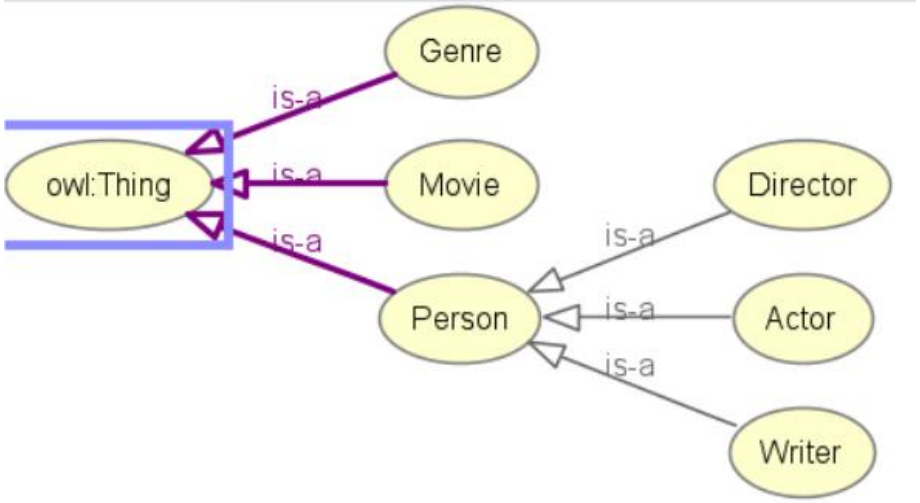
Protégé Editor was used to create this ontology of movies. Basically, we aim to create a blueprint for the online referencing and storage of movie datasets. First, the following classes and properties are required to be set:

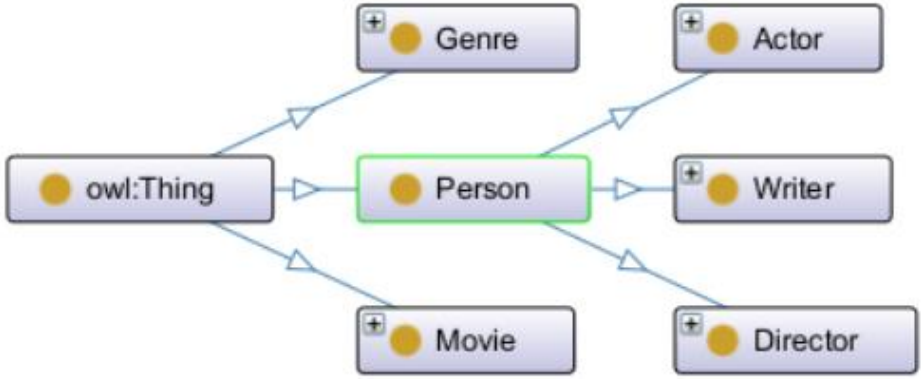
1) **Class:**
   a) Movie: defines basic Movie class
   b) Genre: defines basic Genre class
   c) Person: defines basic Person class
   d) Actor: basic Actor class is a subclass of Person class
   e) Writer: basic Writer class is a subclass of Person
   f) Director: basic Director class is a subclass of Person
2) **Object Property:**
   a) hasGenre: Each Movie has one or more instances of class Genre
   b) hasActor: Each Movie has at least one instance of class Actor
   c) hasWriter: Each Movie has at least one instance of class Writer
   d) hasDirector: Each Movie has at least one instance of class Director
   e) isGenreOf: Inverse of hasGenre
   f) isActorOf: Inverse of hasActor
   g) isDirectorOf: Inverse of hasDirector
   h) isWriterOf: Inverse of hasWriter
3) **Data Property:**
   a) name: Name of Person
   b) age: Age of Person
   c) nationality: Nationality(s) of Person
   d) gender: Gender of Person
   e) genre: Genre(s) of Movie
   f) title: Title of Movie
   g) country: Country(s) of Production of Movie
   h) language: Language(s) of Movie
   i) year: Year of Copyright of Movie

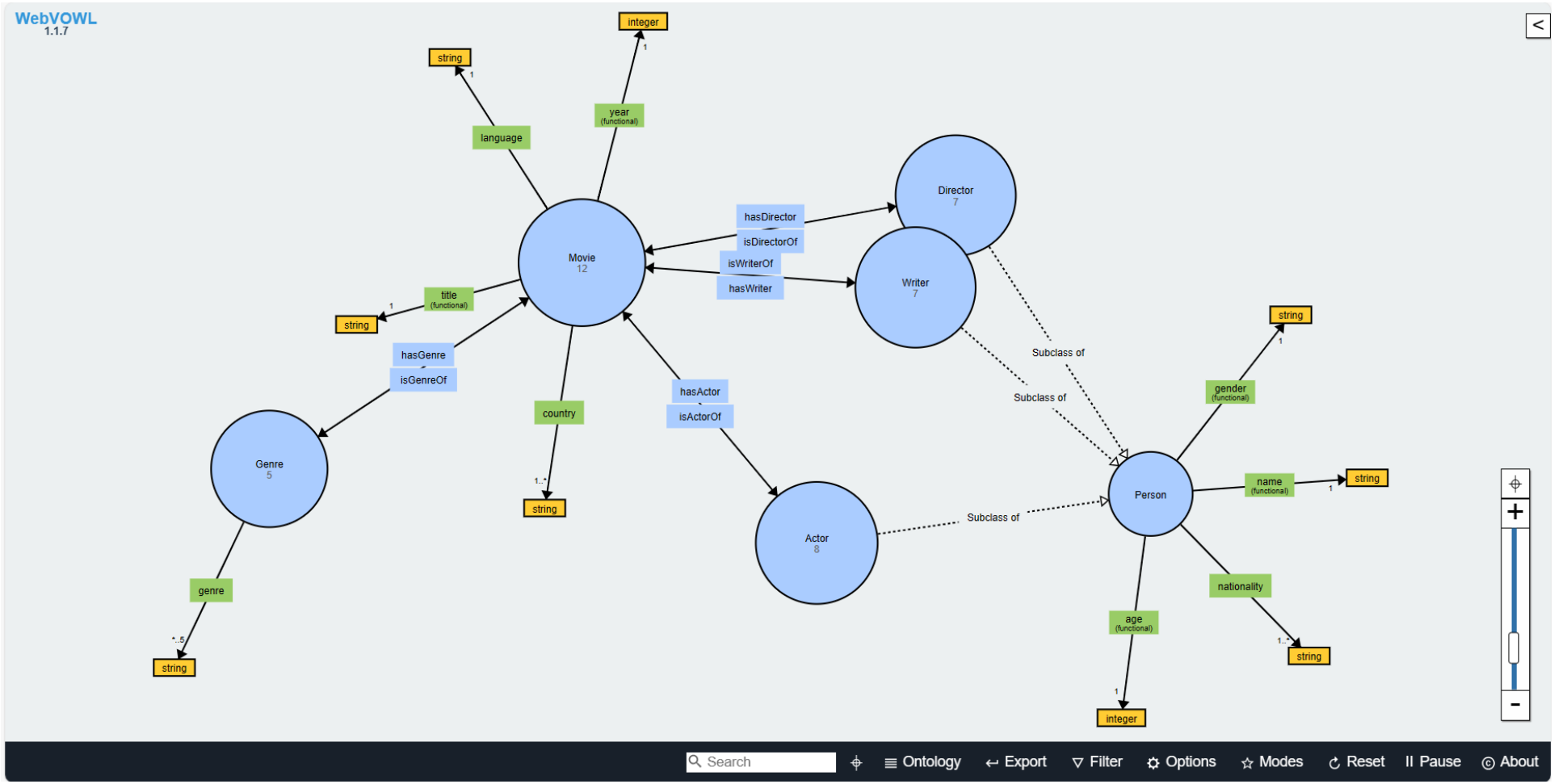
In order to create restrictions and proper relationships between classes and properties, the following assumptions have been observed:

1) Datasets all have films dating from the early 1900s till the current documentation
2) An individual can be an actor or a director or a writer. They can also play multiple roles (ie: an actor can be a director or a writer as well)
3) A Movie cannot have the same values of the Genre as Director, Writer, Actor
4) A Genre cannot have name of Person (Actor, Writer, Director) or Movie
5) hasGenre cannot be equivalent to hasActor, hasDirector, hasWriter between the same individuals.
6) Disjointedness between data properties is always between properties belonging to the same class.
7) Language and Country of a Movie are not equivalent values (ie: A Movie whose country is Canada can have the language France (in English tags only), but France should not be filtered as a country among others in a query searching for country == “France”).
8) Only one name and one title for a Person or a Movie should be registered.
9) There are only 2 genders, male or female.
10) A Movie in a different language is considered a different movie (ie: Sleeping Beauty exists in languages: English, Arabic and Al-Jameela Al-Na’ema also exists in the languages: Arabic, English).
11) Only 1 type of language tags were used, the default English tags. There weren’t explicitly declared.
12) Age 0 means the Person is deceased.
13) A Person (Actor, Director, Writer) can have multiple nationalities.

Finally, view the ontology:



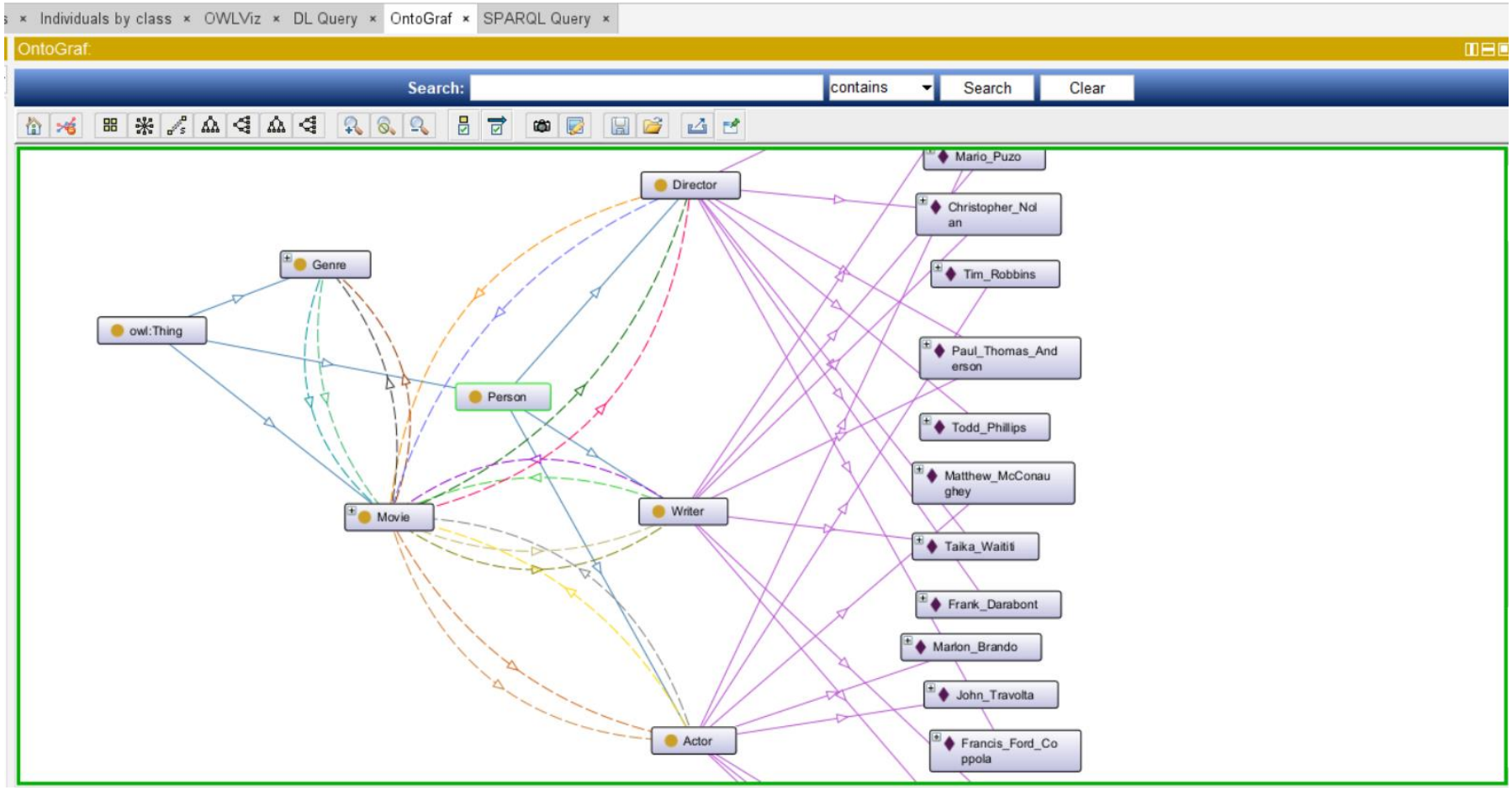



WebVOWL
1.1.7
Movie
12
Director
7
Writer
7
Genre
5
Actor
8
Person
hasDirector
isDirectorOf
isWriterOf
hasWriter
hasGenre
isGenreOf
hasActor
isActorOf
Subclass of
Subclass of
Subclass of
title
(functional)
year
(functional)
language
country
genre
gender
(functional)
name
(functional)
age
(functional)
nationality
string
integer
Search
Ontology
Export
Filter
Options
Modes
Reset
Pause
About

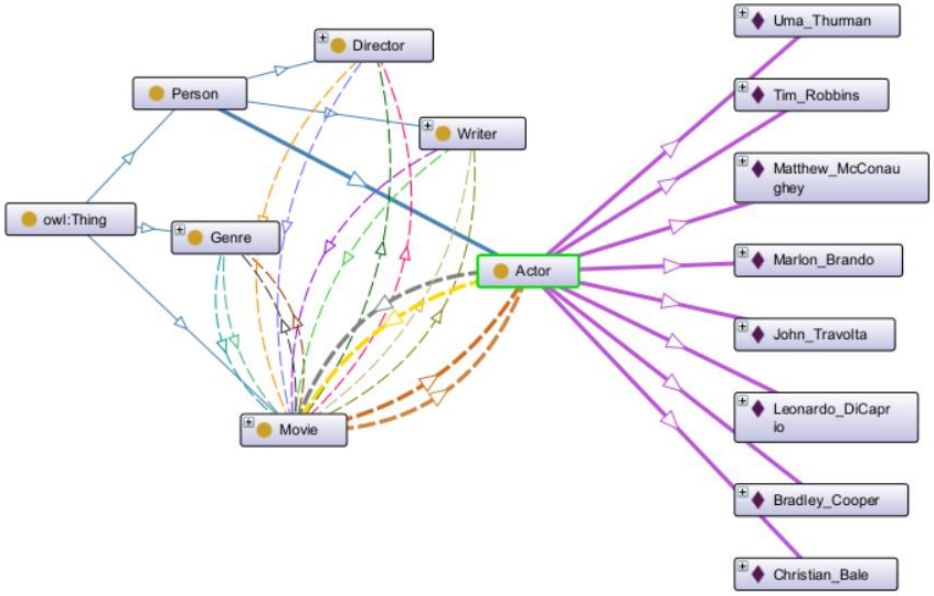
Part II: Populating the Ontology

Now, having designed the ontology, it is time to populate it. Here are some individuals:

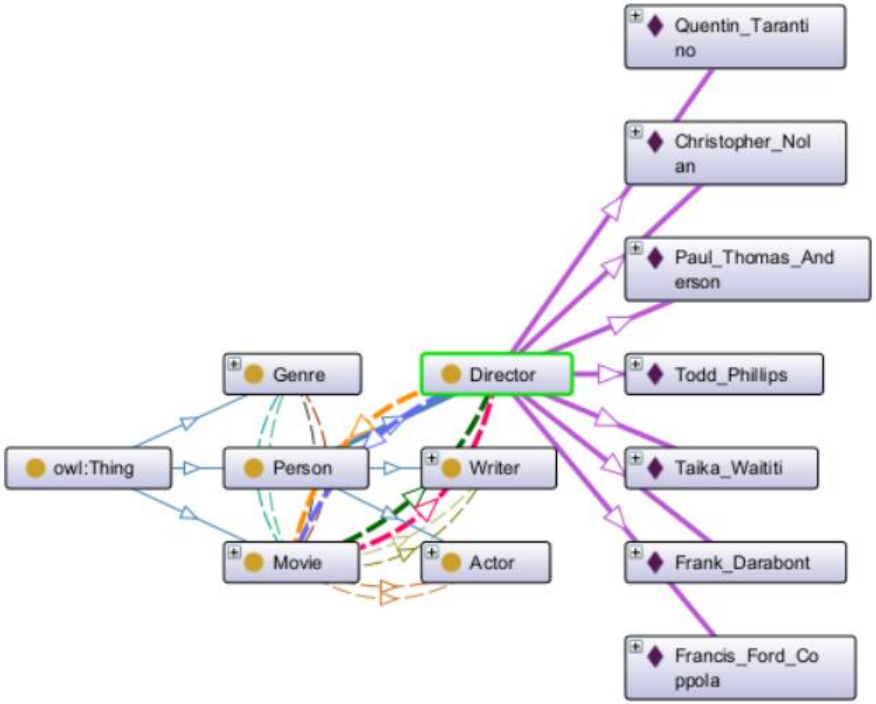
1) **Person (Actor, Director, Writer)**



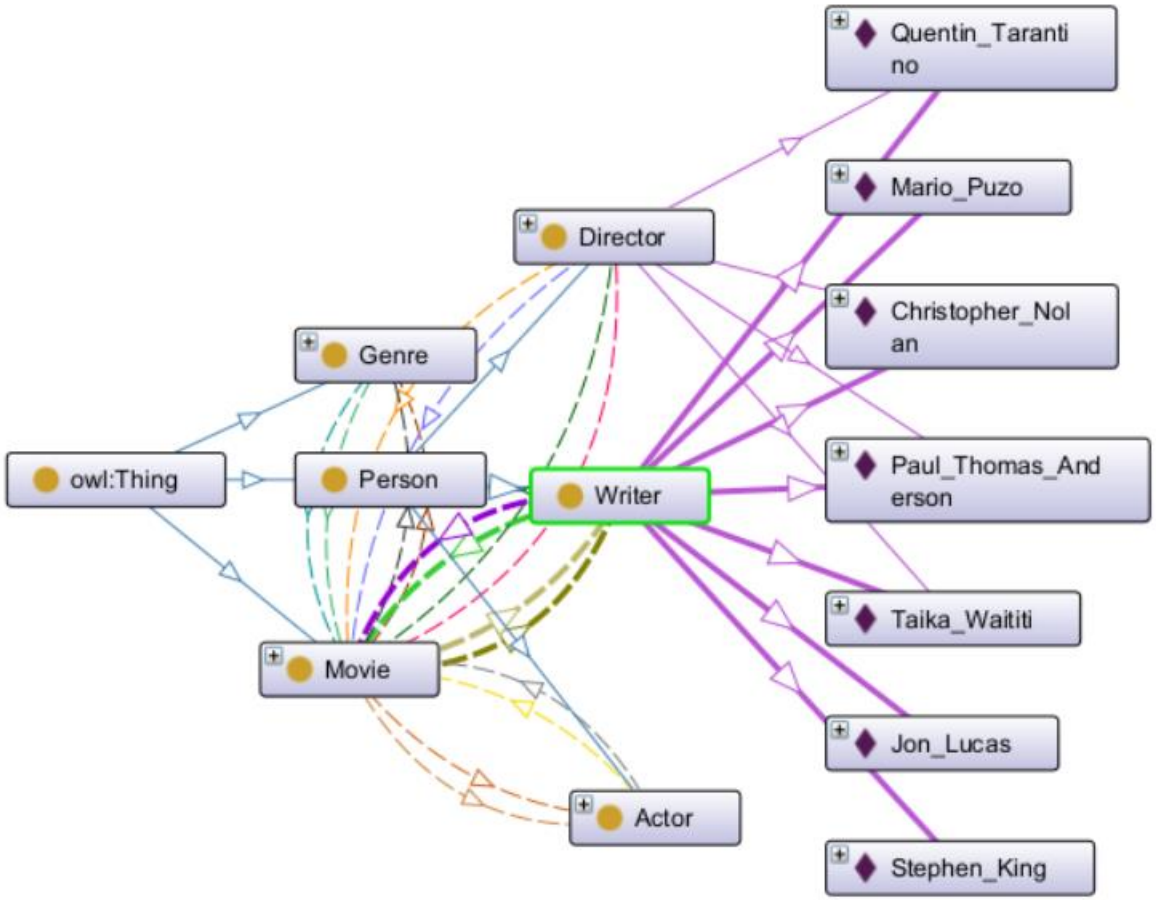
a) Actor



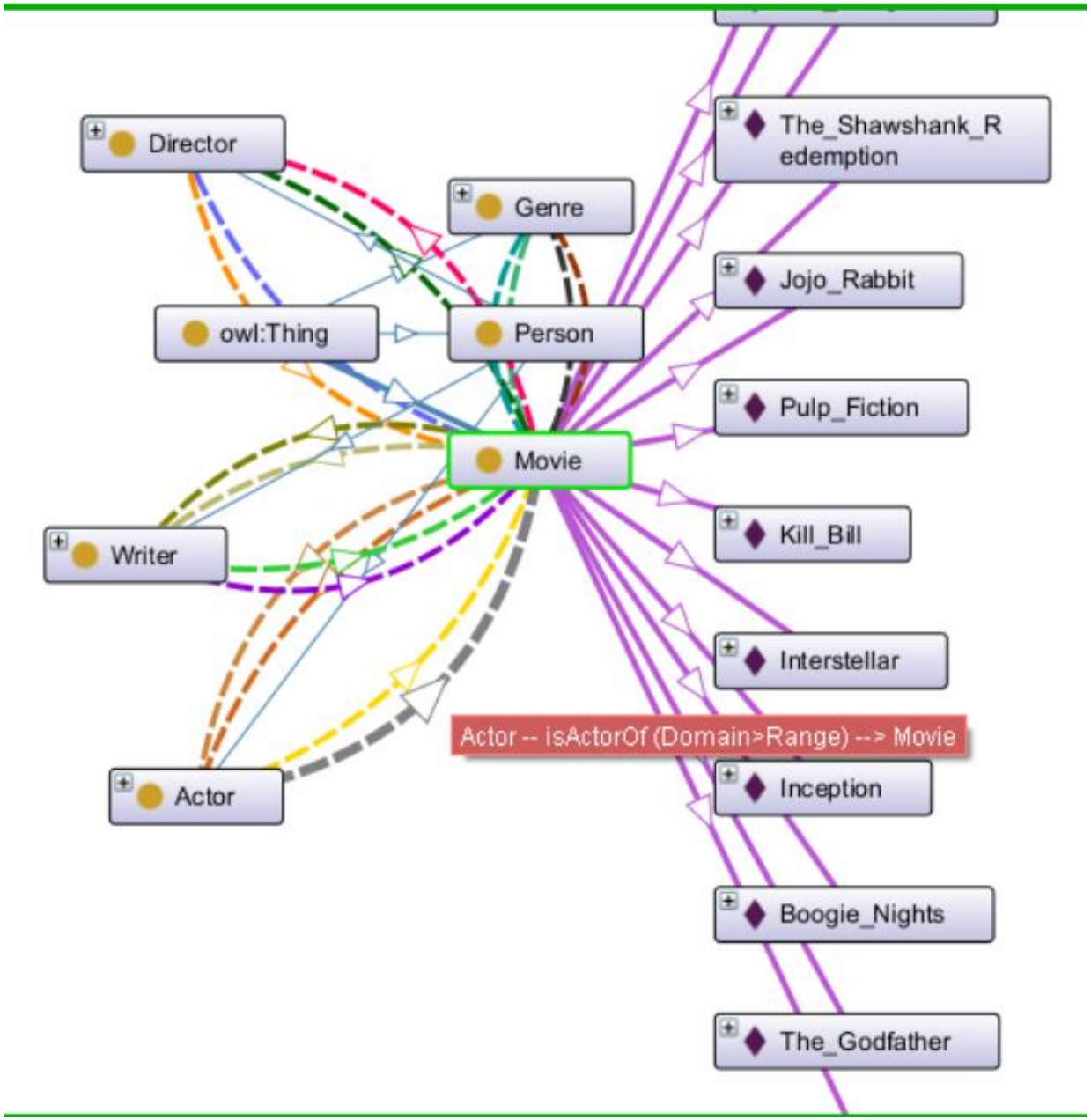
b) Director



c) Writer


Quentin_Taranti
no
Mario_Puzo
Director
Christopher_Nol
an
Genre
Paul_Thomas_And
erson
owl:Thing
Person
Writer
Taika_Waititi
Movie
Jon_Lucas
Actor
Stephen_King

2) Movie


Director
Genre
owl:Thing
Person
Movie
Writer
Actor
The_Shawshank_Redemption
Jojo_Rabbit
Pulp_Fiction
Kill_Bill
Interstellar
Actor -- isActorOf (Domain>Range) --> Movie
Inception
Boogie_Nights
The_Godfather

Finally, test the consistency of the ontology with PELLET reasoner (Turn on Pellet and press CTRL+R)

Below, the restrictions of some object properties and datatype properties are summarized:

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Object Property: hasActor

Annotations (1)

- rdfs:comment "Each Movie has one or more Actor(s)"

Domains (1)

- Movie

Ranges (1)

- Actor

Inverses (1)

- isActorOf

Disjoint Properties (3)

hasActor, hasGenre, isGenreOf

Usage (17)

- Movie ⊆ **hasActor** min 1 Actor
- Boogie_Nights **hasActor** Paul_Thomas_Anderson
- Inception **hasActor** Leonardo_DiCaprio
- Interstellar **hasActor** Matthew_McConaughey
- Jojo_Rabbit **hasActor** Taika_Waititi
- Kill_Bill **hasActor** Uma_Thurman
- Pulp_Fiction **hasActor** John_Travolta
- Pulp_Fiction **hasActor** Quentin_Tarantino
- The_Dark_Knight **hasActor** Christian_Bale
- The_Godfather **hasActor** Marlon_Brando
- The_Hangover **hasActor** Bradley_Cooper
- The_Shawshank_Redemption **hasActor** Tim_Robbins
- There_Will_Be_Blood **hasActor** Paul_Thomas_Anderson
- Thor:Ragnarok **hasActor** Taika_Waititi
- **hasActor** inverse isActorOf
- DisjointProperties(**hasActor**, hasGenre)
- DisjointProperties(**hasActor**, isGenreOf)

Ontologies Classes Object Properties Data Properties Annotation Properties Individuals Datatypes Clouds

Data Property: title

Annotations (1)

- rdfs:comment "Title of Movie" @en

Property Characteristics (1)

- Functional (**title**)

Domains (1)

- Movie

Ranges (1)

- xsd:string

Superproperties (1)

- owl:topDataProperty

Usage (14)

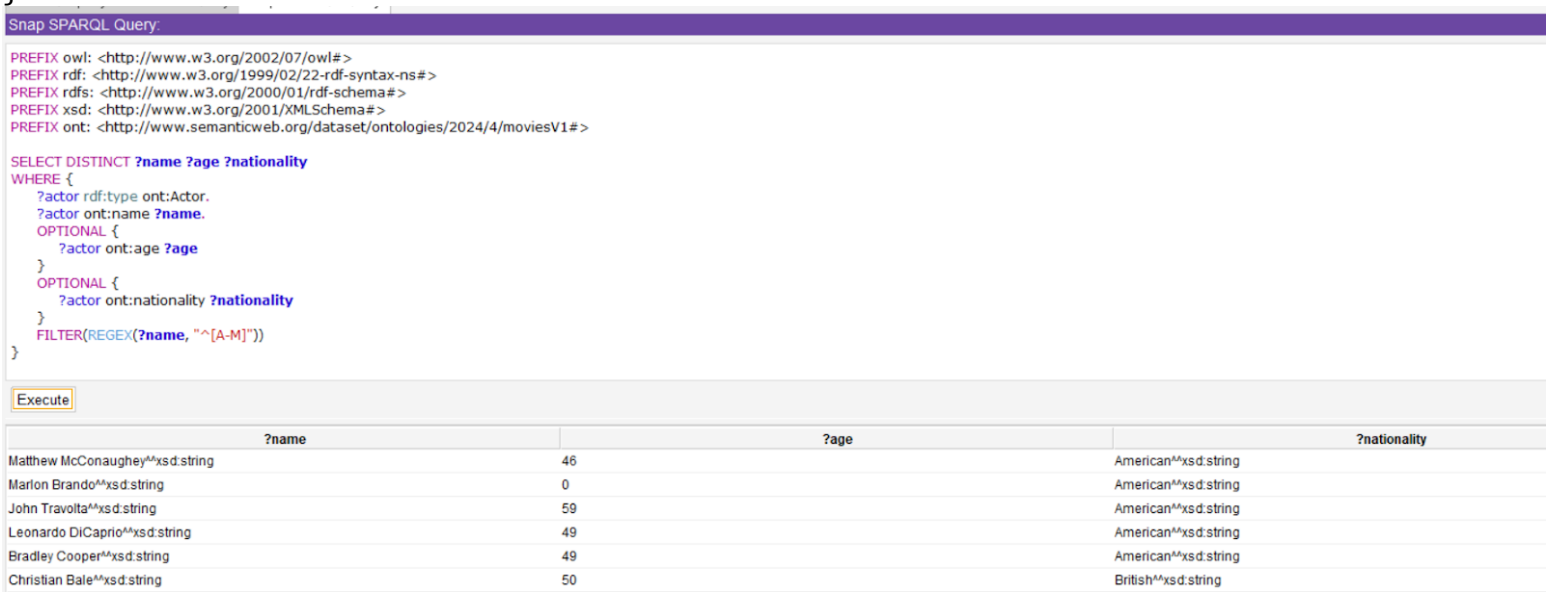
- Movie ⊆ **title** exactly 1 xsd:string
- Boogie_Nights **title** "Boogie Nights"
- Inception **title** "Inception"
- Interstellar **title** "Interstellar"
- Jojo_Rabbit **title** "Jojo Rabbit"
- Kill_Bill **title** "Kill Bill"
- Pulp_Fiction **title** "Pulp Fiction"
- The_Dark_Knight **title** "The Dark Knight"
- The_Godfather **title** "The Godfather"
- The_Hangover **title** "The Hangover"
- The_Shawshank_Redemption **title** "The Shawshank Redemption"
- There_Will_Be_Blood **title** "There Will Be Blood"
- Thor:Ragnarok **title** "Thor: Ragnarok"
- **title** ⊆ owl:topDataProperty

Part III: SPARQL Queries on the Ontology

Start querying your ontology with sparql, use different **types** and nests of queries**.** Each **type of query** is listed with its output:

1) **Query 1: A query that contains at least 2 Optional Graph Patterns and uses a FILTER with regular expressions**
   Query 1: Extracts the names, ages, and nationalities of actors whose names start with letters A-M.

```
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 xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT DISTINCT ?name ?age ?nationality
WHERE {
    ?actor rdf:type ont:Actor.
    ?actor ont:name ?name.
    OPTIONAL {
        ?actor ont:age ?age
    }
    OPTIONAL {
        ?actor ont:nationality ?nationality
    }
    FILTER(REGEX(?name, "^[A-M]"))
}
```



?name	?age	?nationality
Matthew McConaughey^^xsd:string	46	American^^xsd:string
Marlon Brando^^xsd:string	0	American^^xsd:string
John Travolta^^xsd:string	59	American^^xsd:string
Leonardo DiCaprio^^xsd:string	49	American^^xsd:string
Bradley Cooper^^xsd:string	49	American^^xsd:string
Christian Bale^^xsd:string	50	British^^xsd:string

2) **Query 2: A query that contains at least 2 alternatives and conjunctions and uses aggregate functions (COUNT)**

Query 2: Retrieves titles, years, genre names, actor names, and director names for movies released before 2010 and categorized as Action or Thriller, along with the count of genres for each movie.

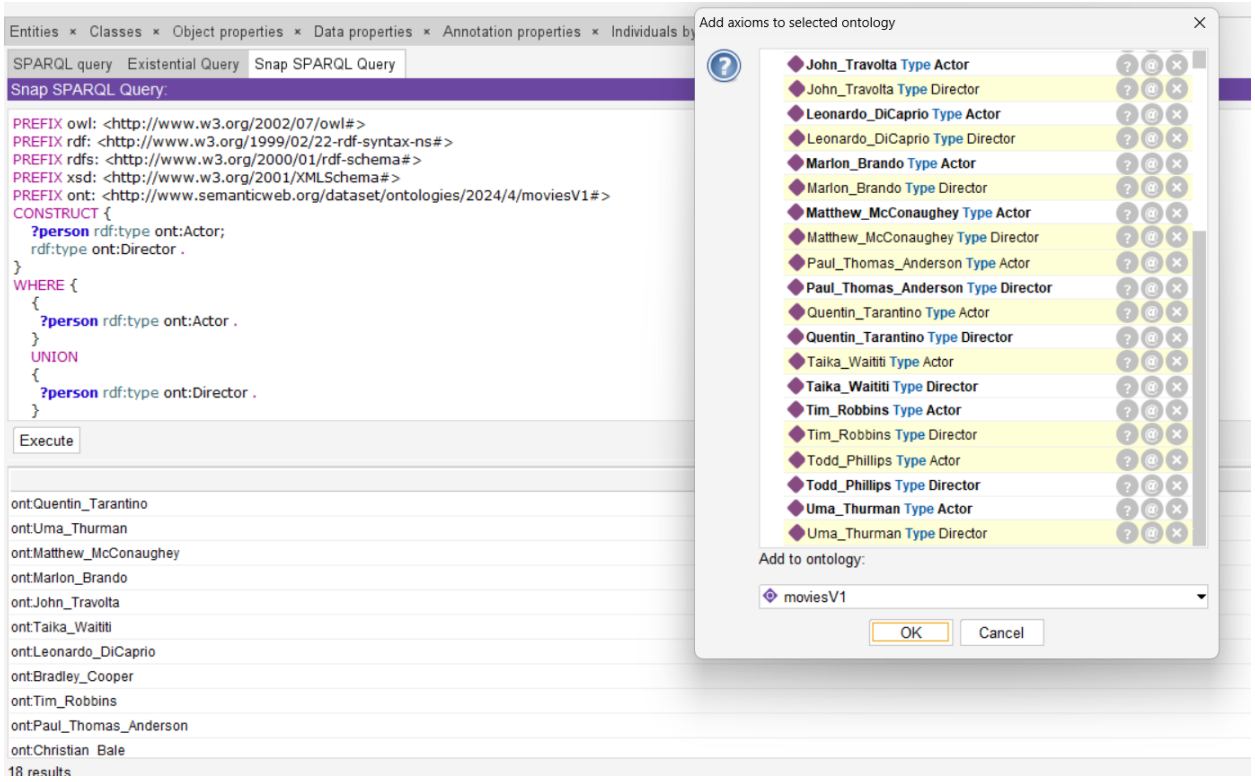
```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT  ?title ?year ?genre_name ?actor_name ?director_name (COUNT(?genre) AS ?genre_count)
WHERE {
   ?movie rdf:type ont:Movie.
   ?movie ont:title ?title.
   ?movie ont:year ?year.
   ?movie ont:hasGenre ?genre.
   ?genre ont:genre ?genre_name.
   {
     ?movie ont:hasActor ?actor_name.
   }
   UNION
   {
     ?movie ont:hasDirector ?director_name.
   }
   FILTER(?year < 2010 && (?genre_name = "Action" || ?genre_name = "Thriller"))
}
GROUP BY ?title ?year ?genre_name ?actor_name ?director_name
```

?title	?year	?genre_name	?actor_name	?director_name	?genre_count
Pulp Fiction^^xsd:string	1994	Thriller^^xsd:string	ont:John_Travolta		1
The Dark Knight^^xsd:string	2008	Action^^xsd:string	ont:Christian_Bale		1
Pulp Fiction^^xsd:string	1994	Thriller^^xsd:string		ont:Quentin_Tarantino	1
There Will Be Blood^^xsd:string	2007	Thriller^^xsd:string		ont:Paul_Thomas_Anderson	1
Kill Bill^^xsd:string	2003	Action^^xsd:string	ont:Uma_Thurman		1
Kill Bill^^xsd:string	2003	Action^^xsd:string		ont:Quentin_Tarantino	1
Kill Bill^^xsd:string	2003	Thriller^^xsd:string	ont:Uma_Thurman		1
Kill Bill^^xsd:string	2003	Thriller^^xsd:string		ont:Quentin_Tarantino	1
There Will Be Blood^^xsd:string	2007	Thriller^^xsd:string	ont:Paul_Thomas_Anderson		1
Pulp Fiction^^xsd:string	1994	Thriller^^xsd:string	ont:Quentin_Tarantino		1
The Dark Knight^^xsd:string	2008	Action^^xsd:string		ont:Christopher_Nolan	1

3) **Query 3: A query that contains a CONSTRUCT query form with nested patterns**

Query 3: Constructs a new RDF graph containing individuals who are both actors and directors.

```
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 xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>
CONSTRUCT {
   ?person rdf:type ont:Actor;
   rdf:type ont:Director .
}
WHERE {
   {
    ?person rdf:type ont:Actor .
   }
   UNION
   {
    ?person rdf:type ont:Director .
   }
}
```



4) Query 4: Count movies with both "Comedy" and "Drama" genres, excluding those released before 2005.

```
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 ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT (COUNT(?movie) AS ?count)
WHERE {
  ?movie rdf:type ont:Movie ;
        ont:hasGenre ?genre ;
        ont:year ?year .
  FILTER((?genre = ont:Comedy) || (?genre = ont:Drama) && ?year >= 2005)
}
```

5) **Query 5: A query that contains a FILTER with date comparison**

Query 5: Fetches titles and release dates of movies released after January 1, 2000.

Query 7: Fetches titles and release dates of movies released after January 1, 2000.

```
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 xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT ?title ?release_date
WHERE {
  ?movie rdf:type ont:Movie ;
         ont:title ?title ;
         ont:year ?release_date .
  FILTER(STR(?release_date) > "2000-01-01")
}
```

Snap SPARQL Query:

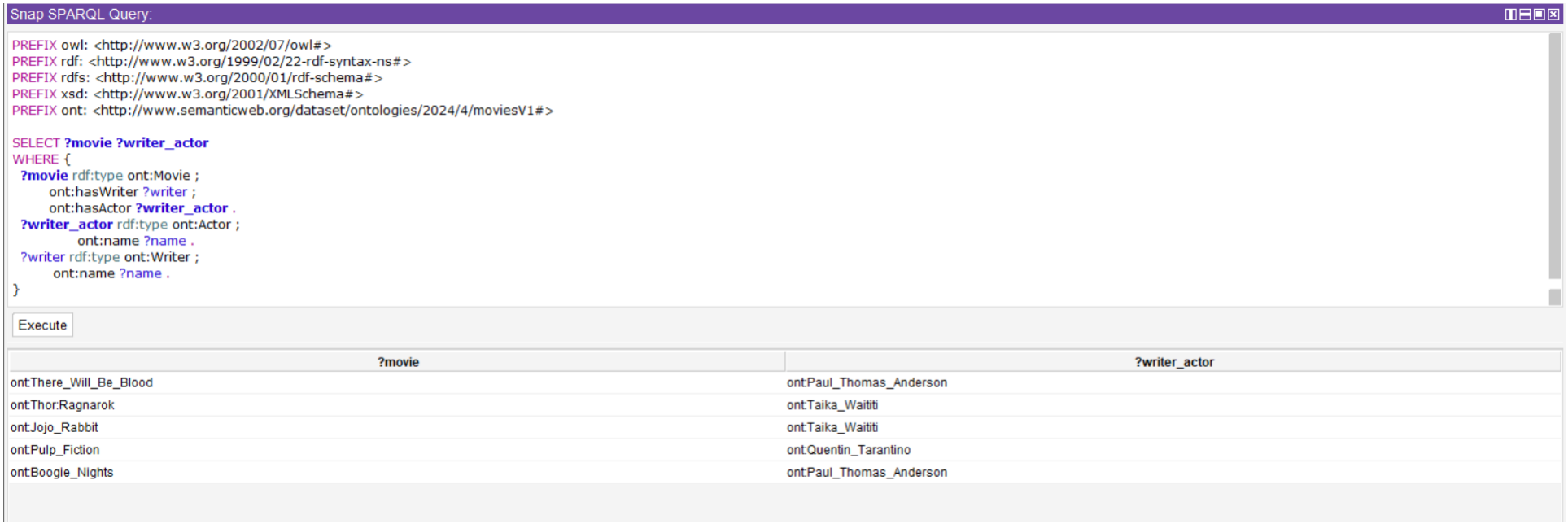
```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT ?title ?release_date
WHERE {
  ?movie rdf:type ont:Movie ;
         ont:title ?title ;
         ont:year ?release_date .
  FILTER(STR(?release_date) > "2000-01-01")
}
```

Execute

?title	?release_date
Inception^^xsd:string	2010
There Will Be Blood^^xsd:string	2007
Thor: Ragnarok^^xsd:string	2017
Jojo Rabbit^^xsd:string	2019
The Hangover^^xsd:string	2009
Kill Bill^^xsd:string	2003
The Dark Knight^^xsd:string	2008
Interstellar^^xsd:string	2014

6) Query 6: Retrieve all movies written by writers who are also actors.

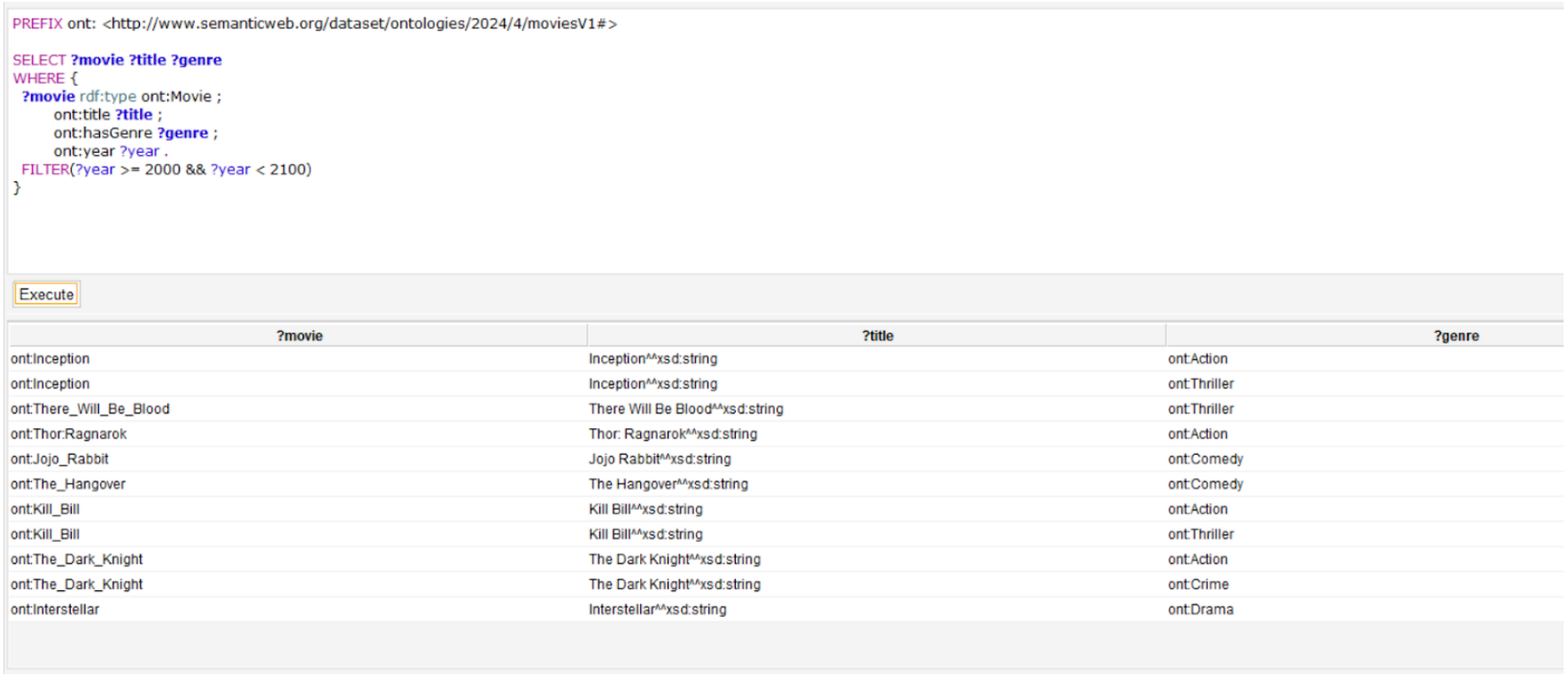
```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT ?movie ?writer_actor
WHERE {
  ?movie rdf:type ont:Movie ;
         ont:hasWriter ?writer ;
         ont:hasActor ?writer_actor .
  ?writer_actor rdf:type ont:Actor ;
                ont:name ?name .
  ?writer rdf:type ont:Writer ;
          ont:name ?name .
}
```



?movie	?writer_actor
ont:There_Will_Be_Blood	ont:Paul_Thomas_Anderson
ont:Thor:Ragnarok	ont:Taika_Waititi
ont:Jojo_Rabbit	ont:Taika_Waititi
ont:Pulp_Fiction	ont:Quentin_Tarantino
ont:Boogie_Nights	ont:Paul_Thomas_Anderson

7) Query 7: Retrieve all movies released in the 21st century along with their titles and genres.

```
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 xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT ?movie ?title ?genre
WHERE {
  ?movie rdf:type ont:Movie ;
        ont:title ?title ;
        ont:hasGenre ?genre ;
        ont:year ?year .
  FILTER(?year >= 2000 && ?year < 2100)
}
```



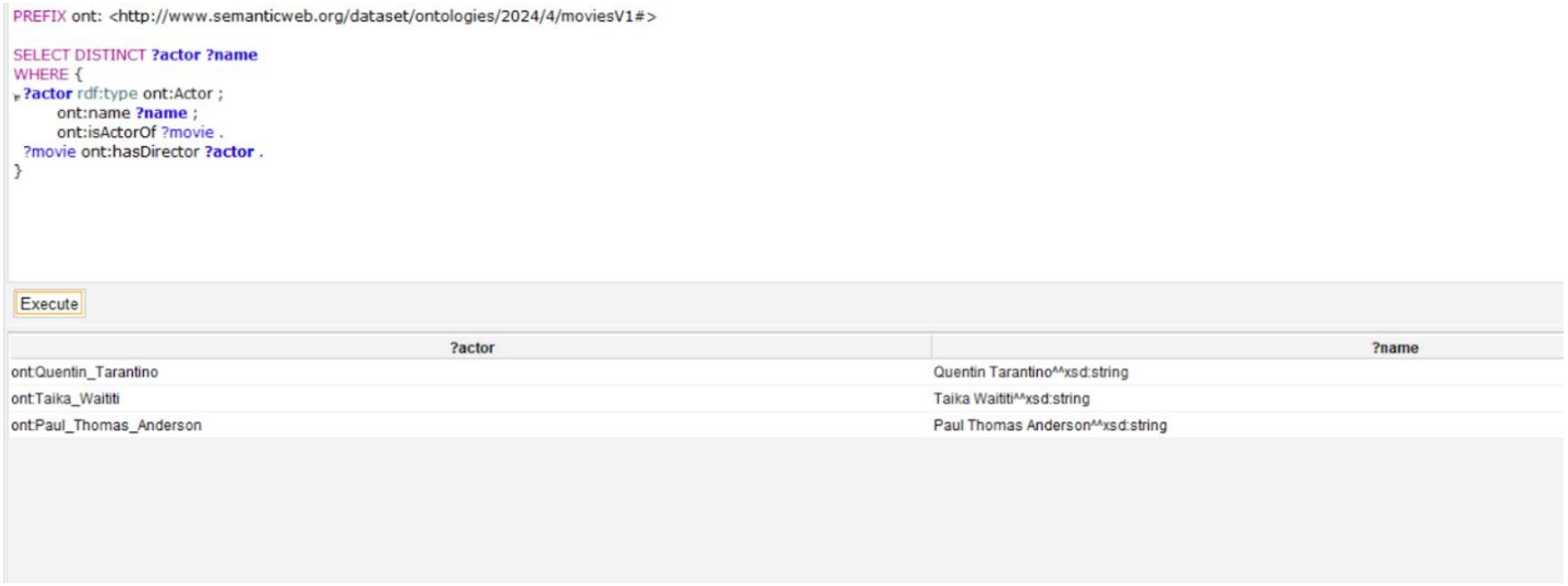
```
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT ?movie ?title ?genre
WHERE {
  ?movie rdf:type ont:Movie ;
        ont:title ?title ;
        ont:hasGenre ?genre ;
        ont:year ?year .
  FILTER(?year >= 2000 && ?year < 2100)
}
```

Execute

?movie	?title	?genre
ont:Inception	Inception^^xsd:string	ont:Action
ont:Inception	Inception^^xsd:string	ont:Thriller
ont:There_Will_Be_Blood	There Will Be Blood^^xsd:string	ont:Thriller
ont:Thor:Ragnarok	Thor: Ragnarok^^xsd:string	ont:Action
ont:Jojo_Rabbit	Jojo Rabbit^^xsd:string	ont:Comedy
ont:The_Hangover	The Hangover^^xsd:string	ont:Comedy
ont:Kill_Bill	Kill Bill^^xsd:string	ont:Action
ont:Kill_Bill	Kill Bill^^xsd:string	ont:Thriller
ont:The_Dark_Knight	The Dark Knight^^xsd:string	ont:Action
ont:The_Dark_Knight	The Dark Knight^^xsd:string	ont:Crime
ont:Interstellar	Interstellar^^xsd:string	ont:Drama

8) Query 8: List all actors who have appeared in movies directed by themselves, along with their names.

```
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 xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>

SELECT DISTINCT ?actor ?name
WHERE {
  ?actor rdf:type ont:Actor ;
        ont:name ?name ;
        ont:isActorOf ?movie .
  ?movie ont:hasDirector ?actor .
}
```



9) **Query 9: A query that contains an ASK query form with negation (MINUS)**
Query 9: Checks if there are movies without the genre "Comedy."

```
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 xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#>


ASK
WHERE {
  ?movie rdf:type ont:Movie .
  MINUS {
    ?movie ont:hasGenre ?genre .
    FILTER(?genre = "Comedy")
  }
}
```

10) **Query 10: A query that contains a DESCRIBE query form with nested properties**
Query 10: Describes information about the Actor class in the ontology.

```
DESCRIBE <http://www.semanticweb.org/dataset/ontologies/2024/4/moviesV1#Actor>
```