Foundations of Semantic Web Technologies

Tutorial 6

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WS 2022/23

Exercise 6.1. Today we will query an RDF graph about the Standard Model of Particle Physics using SPARQL. We will use RDF Playground (`http://rdfplayground.dcc.uchile.cl/`). Copy and paste the following RDF graph describing 19 sub-atomic particles into the text field on the left-hand side and view it as a graph.

```
@prefix : <http://ex.org/>
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

:Up a :Quark ; :spin 0.5 ; :generation 1 ; :interaction :Strong , :EM , :Weak .
:Down a :Quark ; :spin 0.5 ; :generation 1 ; :interaction :Strong , :EM , :Weak .
:Charm a :Quark ; :spin 0.5 ; :generation 2 ; :interaction :Strong , :EM , :Weak .
:Strange a :Quark ; :spin 0.5 ; :generation 2 ; :interaction :Strong , :EM , :Weak .
:Top a :Quark ; :spin 0.5 ; :generation 3 ; :interaction :Strong , :EM , :Weak .
:Bottom a :Quark ; :spin 0.5 ; :generation 3 ; :interaction :Strong , :EM , :Weak .
:Electron a :Lepton ; :spin 0.5 ; :generation 1 ; :interaction :Weak .
:ElectronNeutrino a :Lepton ; :spin 0.5 ; :generation 1 ; :interaction :Weak .
:Muon a :Lepton ; :spin 0.5 ; :generation 2 ; :interaction :Weak .
:MuonNeutrino a :Lepton ; :spin 0.5 ; :generation 2 ; :interaction :Weak .
:Tau a :Lepton ; :spin 0.5 ; :generation 3 ; :interaction :Weak .
:TauNeutrino a :Lepton ; :spin 0.5 ; :generation 3 ; :interaction :Weak .
:Gluon a :GaugeBoson ; :spin 1 ; :mediates :Strong .
:Photon a :GaugeBoson ; :spin 1 ; :mediates :EM  .
:ZBoson a :GaugeBoson ; :spin 1 ; :mediates :Weak  .
:WBoson a :GaugeBoson ; :spin 1 ; :mediates :Weak  .
:Higgs a :ScalarBoson ; :spin 0 .

:Neutron a :Baryon ;
:contains [ :component :Up ; :quantity 1 ] , [ :component :Down ; :quantity 2 ] .
:Proton a :Baryon ;
:contains [ :component :Up ; :quantity 2 ] , [ :component :Down ; :quantity 1 ] .
```

For each of the following questions your answer should be a SPARQL query. You can test these queries by using the SPARQL tab of the right-hand side. Be sure to add `PREFIX : <http://ex.org/>` to make your life easier. When you write a query select the operation type (unless otherwise stated use `SELECT` queries) and whatever result format you prefer (*Text* is best for `SELECT` and `ASK`, *TTL* for `CONSTRUCT`). The queries should not introduce more information than in the question; for example, if the question asks for the force mediated by gluons, you cannot simply insert `:Strong` in the query, but rather the query should find `:Strong`. Note that the term "particle" is used like "resource" or "entity" in order to phrase the questions more naturally; you do not need to explicitly check that something is of type particle in the query (though for more specific types like leptons, muons, etc., you should check the type). *Let's begin!*

(a) Find the spin of a photon.

(b) Find particles that mediate the weak force and their spin.

(c) Find particles that interact through the force mediated by gluons.

(d) Find the unique forces through which each baryon interacts based on its components.

(e) Find particles whose spin is a whole number.

(f) Find particles that interact through the force mediated by gluons or photons.

(g) Find particles with positive spin (> 0) and, if given, their generation (if not, still return the result).

(h) Find particles that interact through the weak force but not the strong force.

(i) Find if there are particles with lower ($<$) spin than a muon (use `ASK`).

(j) Create the following graph connecting quarks in the next or previous generation (use `CONSTRUCT`).

```
@prefix : <http://ex.org/>

:Up :nextGeneration :Charm , :Strange .
:Down :nextGeneration :Charm , :Strange .
:Charm :nextGeneration :Top , :Bottom ; :prevGeneration :Up , :Down .
:Strange :nextGeneration :Top , :Bottom ; :prevGeneration :Up , :Down .
:Top :prevGeneration :Charm , :Strange .
:Bottom :prevGeneration :Charm , :Strange .
```