6. Semantics of RDF

The purpose of this lab is to improve your understanding of the semantics of RDF.

Propositional Logic

1. Provide all truth assignments that satisfy these formulae:

   (a) $study \leftrightarrow clever$

   (b) $work \wedge behave \rightarrow promotion$

   (c) $\neg eat \vee \neg drink \vee \neg breathe \rightarrow \neg live$

2. Does this entailment hold?

$$\neg eat \vee \neg drink \vee \neg breathe \rightarrow \neg live \models \neg breathe \rightarrow \neg live$$

First-order Logic

1. Provide a model for this formula:

$$\forall x\,(Museum(x) \rightarrow TourismAttraction(x)) \wedge$$
$$\forall x\,(\exists y\, star(x, y) \rightarrow Hotel(x)) \wedge Museum(museion) \wedge star(laurin, 4)$$

2. Recap the notions "theory", "logical consequence" and "equivalence" and decide if the following claims are true or false for FOL. Give an informal justification for your answer.

   For arbitrary theories $\mathcal{T}$ and $\mathcal{S}$ holds:

   (a) If a formula (axiom) F is generally valid, then $\mathcal{T} \models F$, i.e., every theory has at least all tautologies as consequence.

   (b) The more axioms a theory contains the more models it has. More precisely: if $\mathcal{T} \subseteq \mathcal{S}$, then every model of $\mathcal{T}$ is a model of $\mathcal{S}$.

   (c) The more axioms a theory contains, the more logical consequences it has. More precisely, if $\mathcal{T} \subseteq \mathcal{S}$, then every logical consequence from $\mathcal{T}$ is also a consequence from $\mathcal{S}$.

   (d) If $\neg F \in \mathcal{T}$, then $\mathcal{T} \models F$ can never hold (F being an arbitrary formula).

   (e) If two theories differ syntactically ($\mathcal{T} \neq \mathcal{S}$), then they differ in at least one logical consequence (e.g., through the existence of a formula F with $\mathcal{T} \models F$ but $\mathcal{S} \not\models F$).

Simple Interpretations

1. Provide a model for this graph G:

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

:laurin :type :Hotel .
:laurin :star "4" .
_:someHotel :star "1" .
```

2. Does the graph G entail the following graph?

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

_:b1 :type _:b2 .
```

RDF Interpretations

1. Recall the graph G. Provide 10 RDF-inferred facts of G.
2. Decide if the following propositions are true or false:
   (a) Blank nodes can stand for arbitrary resources.
   (b) URIs can stand for arbitrary resources.
   (c) Every blank node has an ID.
   (d) Two blank nodes with different IDs can stand for the same resource.
   (e) Two different URIs can stand for the same resource.
   (f) Blank nodes carrying the same ID that occur in several RDF documents must stand for the same resource.
   (g) URIs that occur in several RDF documents must stand for the same resource.
   (h) Two different Literals can never stand for the same value.
   (i) Two Literals with different datatype can never stand for the same value.
   (j) A URI can never stand for a datatype value.
   (k) Blank nodes cannot occur in the predicate position of triples.
   (l) Blank nodes cannot stand for properties (that is, resources that belong to the class `rdf:Property`).

First-order Logic and SPARQL

Suppose that a vocabulary consists of the IRIs `:hasFriend`, `:likes` and `:Person`.[1]

1. Provide a first-order logic representation of the query "Give me all people who are liked by all their friends".
2. Translate the FOL representation into a SPARQL 1.1 query that has the same intended semantics.

[1] Suppose the default prefix is `http://example.org/`.