

Exercise Sheet 2: RDF Modelling
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Exercise 2.1. Which of the following literals describe the same value? Explain your answer.

1. "2"^^xsd:integer vs. "2.0"^^xsd:decimal
2. "2"^^xsd:decimal vs. "2"^^xsd:float
3. "2018-11-06T15:40:00+01:00"^^xsd:dateTime vs. "2018-11-06T14:40:00Z"^^xsd:dateTime
4. "2018-11-06T15:40:00+01:00"^^xsd:dateTime vs. "2018-11-06T14:40:00"^^xsd:dateTime

A detailed description of each of the various XML Schema datatypes is given in the online specification: see <https://www.w3.org/TR/xmlschema11-2/>.

Exercise 2.2. Recall that blank nodes act as placeholders for arbitrary resources in RDF: they assert that there is something without saying what it is. Such an assertion might logically follow from other, stronger assertions, so that some triples in a graph might be redundant. For example, the second triple in the following dataset can be omitted without loss of information:

```
eg:s    eg:p    eg:o .
_:1     eg:p    _:2 .
```

More generally, an *instance* of an RDF graph G is a graph $\sigma(G)$ obtained by applying a function σ that maps blank nodes to arbitrary RDF terms. A graph is *lean* if it does not have any instance $\sigma(G) \subset G$ that is strictly contained in G . In the example, $\sigma = \{_:1 \mapsto \langle s \rangle, _:2 \mapsto \langle o \rangle\}$ shows that this graph is not lean.

Determine if the following graphs are lean:

- | | |
|--|--|
| <p>(a) <pre>eg:s eg:p eg:o . _:1 eg:p _:1 .</pre></p> | <p>(c) <pre>eg:s eg:p eg:o . _:1 eg:p [eg:p []] .</pre></p> |
| <p>(b) <pre>eg:s eg:p _:2 . _:1 eg:p eg:o .</pre></p> | <p>(d) <pre>eg:s eg:p eg:s . _:1 eg:p [eg:p []] .</pre></p> |

* **Exercise 2.3.** Show that it is NP-complete to decide if an RDF graph is not lean.

Hint:

Start from embedding into itself
 conjunctive is not hard. Making it lean if it is not conjunctive requires some trick to prevent the encoding for hardness, and a reduction from 3-conjunctivity. Making an RDF graph non-lean if a graph is

Exercise 2.4. The bibliographic database DBLP¹ offers individual data records as RDF in N-Triples format. This data can be downloaded from the URL obtained by appending .nt to the URI. Use this interface to find all publications that have <https://dblp.org/pid/s/RudiStuder.html> as their only author.

- Download some RDF files in your browser to find out how this information is encoded.

¹<https://dblp.org>

- Write a program that crawls a small part of the data to answer the query.

Note: If your program sends too many requests in a short time, the server will deny the request and cancel the connection. Dirty trick: use `time.sleep(1)` before executing a request.

Hint: `requests`² provides a high-level API for making HTTP requests in Python, but you may need to install it, e.g., using `pip`.³ A built-in alternative that provides a lower-level interface is `urllib.requests`.⁴

* **Exercise 2.5.** Let $G = \langle V, E \rangle$ be an undirected graph. Show that if G is triangle-free (i.e., there are no triangles in G), then

$$|E| \leq \left\lfloor \frac{|V|^2}{4} \right\rfloor.$$

²<https://requests.readthedocs.io/en/latest/>

³<https://pypi.org/project/pip/>

⁴<https://docs.python.org/3/library/urllib.request.html>