IN3060/4060 – Semantic Technologies – Spring 2021

Lecture 2: Resource Description Framework (RDF)

Jieying Chen

22nd January 2021

Department of Informatics

University of Oslo

Today's Plan

Mandatory exercises

- First oblig published today (22.01) after lecture.
- Topic RDF.
- Hand in by next Friday (29.01).
- Same schedule for the other small obligs:
  - #2 (29.01 – 05.02),
  - #3 (05.02 – 12.02), and
  - #4 (19.02 – 05.03).
- The larger obligs with two possible attempts:
  - #5 (05.03 – 19.03) and
  - #6 (26.03 – 16.04).
- And one short oblig about OTTR
  - #7 (07.05 – 14.05).
- See *obliger* on the semester page.
- Mr. Oblig.

Outline

RDF: W3C Overview

- *The Resource Description Framework* (RDF) is a standard model for data interchange on the Web.

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- Thus allows data to be mixed, exposed, and shared across different applications.
- This linking structure forms a directed, labelled graph.
- This graph view is the easiest possible mental model for RDF and is often used in easy-to-understand visual explanations.

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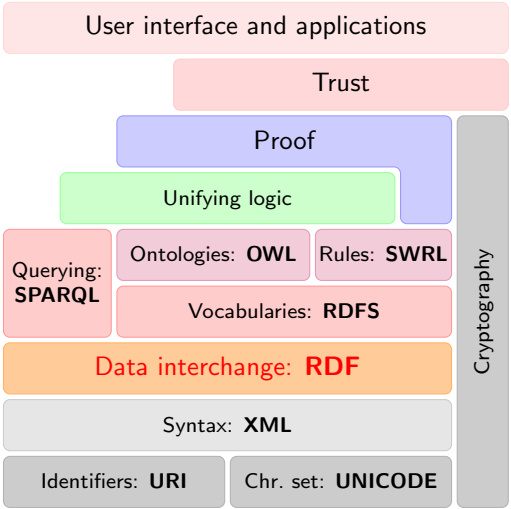
Semantic Web Stack

- Central block in the SW stack.



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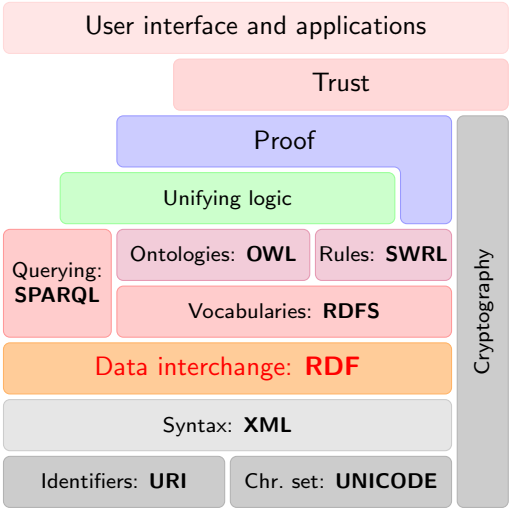

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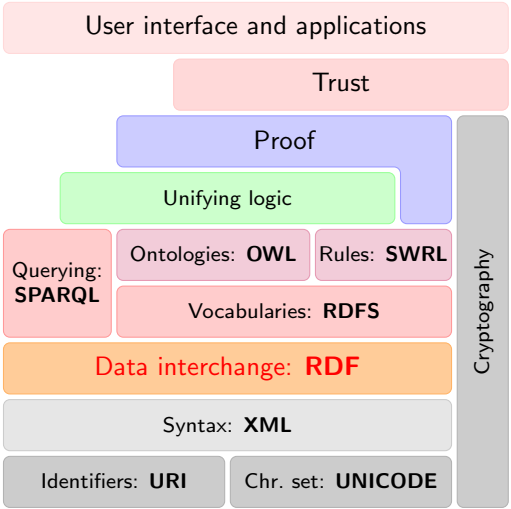

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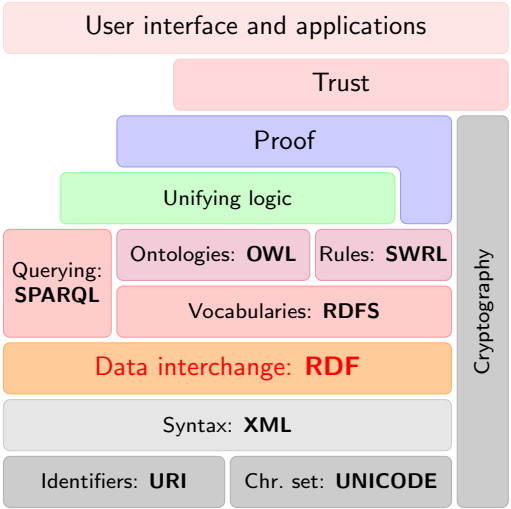

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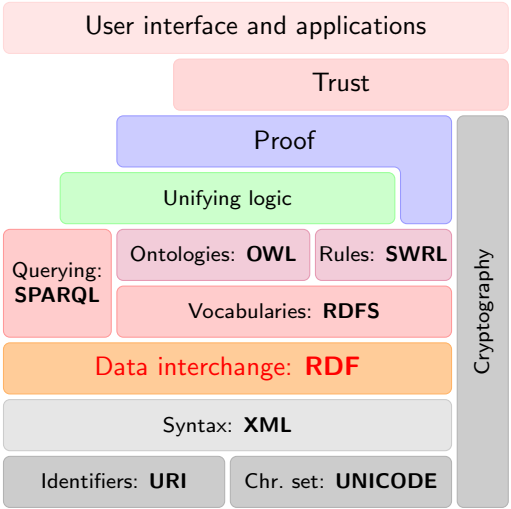

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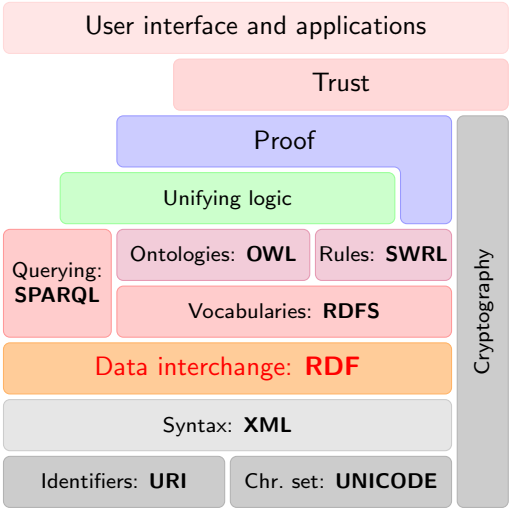

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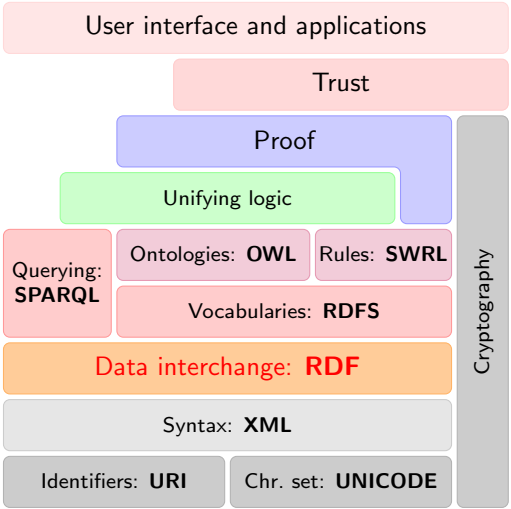

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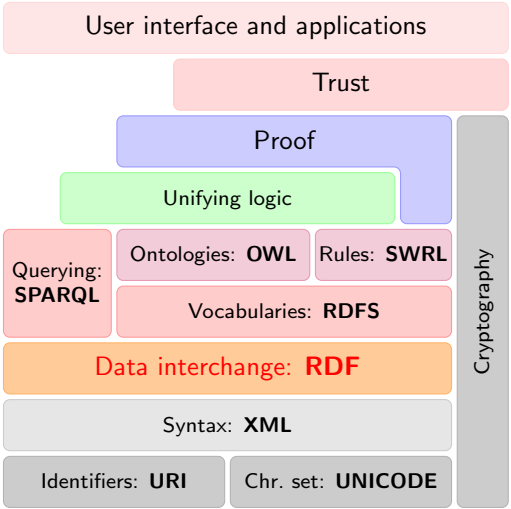

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- It is considered the basic representation format underlying the Semantic Web.

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- Remember: It's all just URIs!

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- We cannot have one URI for every integer, decimal number, string etc.

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- One can also specify the language of a string using a *language tag*:

```
dbp:Norway rdfs:label "Norge"@no .
dbp:Norway rdfs:label "Norwegen"@de .
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RDF Graphs

- An *RDF graph* is a set of triples. E.g.,

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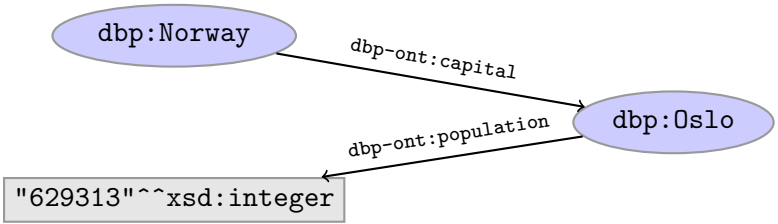
- RDF graphs are often represented as a directed labelled graph:



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  dbp:UiO dbp-ont:hasAddress "Problemveien 7 0313 Oslo" .
- As several literals?

  dbp:UiO dbp-ont:addressPlace "Oslo" .
  dbp:UiO dbp-ont:addsressStreet "Problemveien" .
  dbp:UiO dbp-ont:addressStreetNumber "7" .
  dbp:UiO dbp-ont:addressPostcode "0313" .

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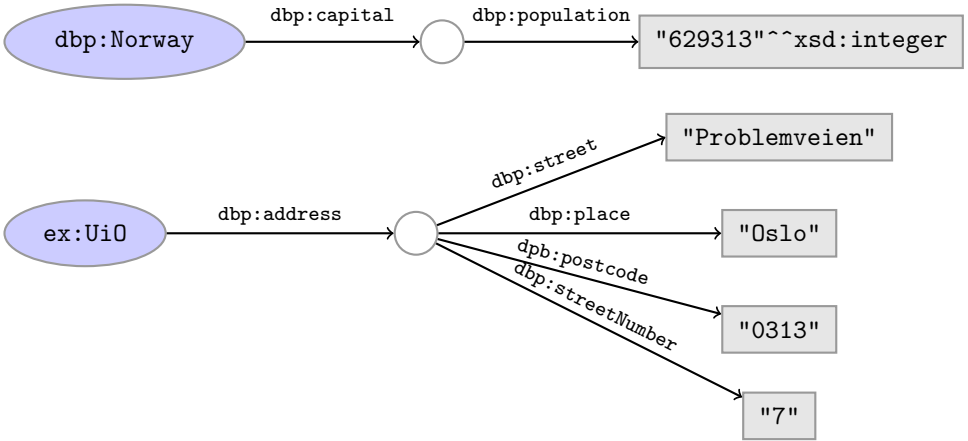
- Use when resource is unknown, or has no (natural) identifier. E.g.:



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✔	✔	✔

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  - to restructure the XML schema.

Outline

RDF Serialisations

There are many serialisations for the RDF data model:

RDF/XML the W3C standard. Complicated!

```
<?xml version="1.0"?>
<rdf:RDF xmlns:dbp="http://dbpedia.org/resource/"
 xmlns:foaf="http://xmlns.com/foaf/0.1/"
 xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns\#">
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Others N3, TriX, TriG, RDF/JSON, ...

Turtle: URI references and triples

Full URIs are surrounded by < and >:

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      <http://dbpedia.org/ontology/Place> .
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Turtle allows any non-zero amount of space between elements in triples.

Turtle: Namespaces

QNames are written without any special characters.

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Namespace prefixes are declared with `@prefix`:

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A default namespace may be declared:

```
@prefix dbp: <http://dbpedia.org/resource/> .
@prefix : <http://dbpedia.org/ontology/> .

dbp:Oslo a :Place .
```

Turtle: Literals

Literal values are enclosed in double quotes:

```
@prefix dbp: <http://dbpedia.org/resource/> .
@prefix : <http://dbpedia.org/ontology/> .

dbp:Norway :officialName "Norge" .
```

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```

Possibly with type or language information:

```
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```

Numbers and booleans may be written without quotes:

```
dbp:Oslo :population 629313 .
dbp:Oslo :isCapital true .
```

Turtle: Statements sharing elements

Instead of:

```
dbp:Oslo rdf:type dbo:City .
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```

. . . and in combination:

```
dbp:Norway rdfs:label "Norway"@en, "Norwegen"@de, "Norge"@no ;
           :capital dbp:Oslo .
```

Turtle: Blank nodes

Blank nodes are designated with underscores or `[...]`.

Norway has a capital with population 629313:

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dbp:Norway :capital _:someplace .
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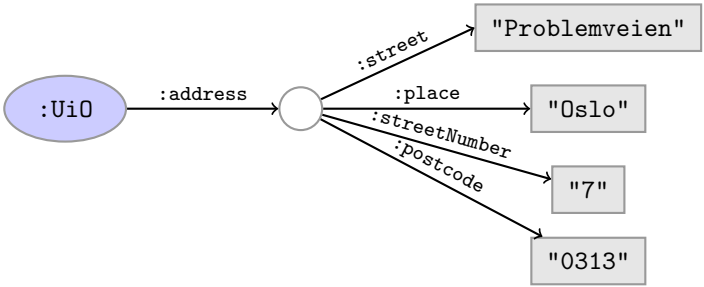
UiO has address Problemveien 7, 0313 Oslo:

```
:UiO :address [ :street "Problemveien" ;
                :streetNumber "7";
                :place "Oslo" ;
                :postcode "0313" ] .
```

Question

The blank node here:

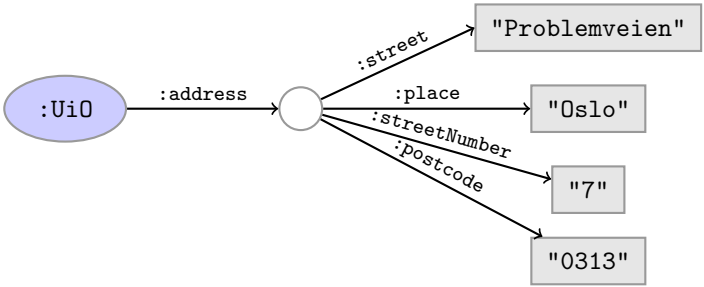


has no ‘name.’

Why does Turtle use ‘blank node identifiers’ like `_:someplace`?

Question

The blank node here:



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Why does Turtle use ‘blank node identifiers’ like `_:someplace`?

Answer: makes it easy to use same node in several triples.

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Use '#' to comment:

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Use '\' to escape special characters:

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:someGuy :foaf:name "James \"Mr. Man\" Olson" .
```

Turtle specification: `http://www.w3.org/TR/turtle/`.

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Vocabularies

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`rdf:` `<http://www.w3.org/1999/02/22-rdf-syntax-ns#>` – RDF
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  - `@prefix rdf:` `<http://xmlns.com/foaf/0.1/>` would be highly irregular.

Example vocabularies: RDF, RDFS

Some example resources:

RDF: describing RDF graphs.

- `rdf:Statement`
- `rdf:subject`,
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Examples:

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dbp:Oslo rdf:type dbp-ont:Place .
dbp:Norway rdfs:label "Norge"@no .
dbp:Capital rdfs:subClassOf dbp:City .
```

Example vocabularies: FOAF, Dublin Core

Some example resources:

FOAF: person data and relations.

- `foaf:Person`
- `foaf:knows`
- `foaf:firstName`,
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Examples:

```
ifi:jieyingc rdf:type foaf:Person .
ifi:jieyingc foaf:knows ifi:martingi .
ifi:jieyingc dcterms:creator ifi:rdf-lecture .
```

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- Use `http://www.example.[com|net|org]` for prototyping and documentation.

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Tim Berners-Lee's recipe for 5 star web data:

1. Make data available on the Web (any format) under an open license.

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5. Link your data to other's data to provide context.

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Web of Data

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- Decouples data from applications.
- Lightens the programming burden.
- Semantic Web applications should be/are generic and general purpose, exploiting rich and knowledge intensive data sets.

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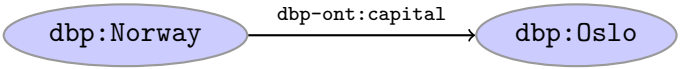
  - Again, put data on the URI address.
- *Trust* is an important (and work-in-progress) layer in the SW stack.

RDF graphs are not graphs



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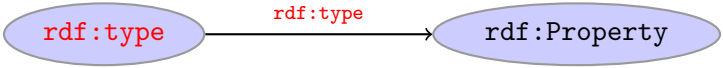

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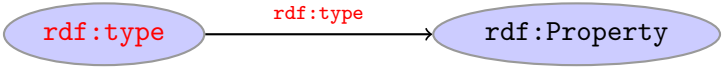

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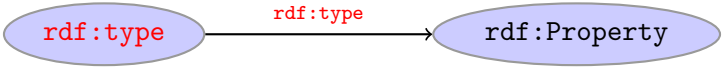

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- RDF graphs are sets of triples, not graphs.
- The set of nodes, i.e., subjects and object, and edges, i.e., predicates, of an RDF graph need not be disjoint.

Be careful when merging RDF *files*

Merging the two RDF files containing named blank nodes

File 1

```
ifi:martige :owns _:myCar .
_:myCar a  lotus:Esprit .
```

File 2

```
ifi:martingi :owns _:myCar .
_:myCar    a    iicv:Sahara .
```

gives the RDF graph:

File 1 ∪ File 2

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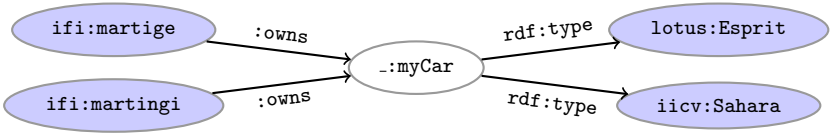

Rename blank nodes

Renaming `_:myCar` to `_:myCar2` in File 2.

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More complex statements

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Data structures

```
:in3060 :hasLecturers
          [ rdf:first :martingi ;
            rdf:rest [ rdf:first : jieyingc;
                       rdf:rest [ rdf:first :olemholt ;
                                  rdf:rest rdf:nil .
                                ] .
                     ] .
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Turtle shorthand for lists

```
:in3060 :hasLecturers (:martingi :jieyingc :olemholt ) .
```

More complex statements (cont.)

What if I want to state that "Jieying thinks iOS is better than Linux, but Martin does not."

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Reification, statements describing statements

```
_:s rdf:subject ex:ios ;
    rdf:predicate ex:betterThan ;
    rdf:object ex:linux .

:jieyingc :thinks _:s .
:martingi :thinksNot _:s .
```

More complex statements (cont.)

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Reification allows us to describe agents' (e.g. people, sensors) beliefs, knowledge, etc. or meta information about a statement, e.g. "added by", "imestamp", etc.

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- Is completely independent of any application.

That's it for today!

Remember the mandatory assignment.