ActiveRaUL: Automatically generated Web Interfaces for creating RDF data

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Introduction

The amount of semantic Web data is still many orders of magnitude smaller than the World-Wide-Web. One of the barriers for semantic Web novices to create machine-readable data is the lack of easy-to-use Web publishing tools that separate the schema modelling from the data creation. We present **ActiveRaUL**, a Web form-based user interface that particularly supports users inexperienced in semantic Web technologies in creating RDF data. These Web form-based user interfaces in ActiveRaUL can be automatically generated from any arbitrary input ontology.

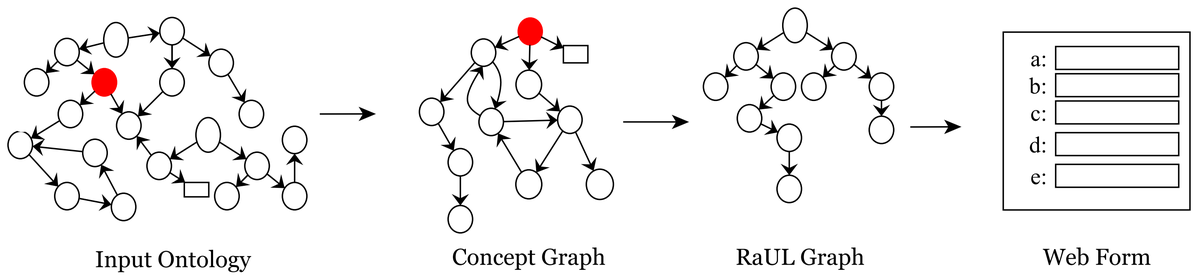
Challenges:

- Mismatch between **graph based data model** of an ontology and the **tree based data model** of Web forms.
- Incompatibility of the **triple model** of RDF to a **key-value pair** of Web form.
- Creating **objects** for object properties from Web form fields rather than **standard datatypes**.
- **Reuse of individuals** across different Web forms.

Solutions:

- **Extract relationships** among the concepts form arbitrary input ontology.
- **Avoid cycles** of an RDF graph by removing *inferable properties* of the ontology.
- **Use RaUL Ontology** - an `RDF representation of Web form elements-to:`
  - o map `acyclic RDF graph` to `tree based data model` of Web forms
  - o map `RDF triple` to `key-value pair` of Web forms
  - o encode information about `objects` creation from Web form fields

Method



Input Ontology Concept Graph RaUL Graph Web Form

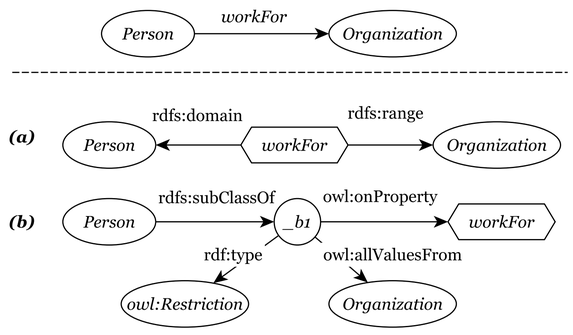
- A user provides input ontology through ActiveRaUL web interface or API and selects a concept - **the concept node**.
- ActiveRaUL constructs a **concept graph** which is composed of relationships of the concept node.
- ActiveRaUL creates a **RaUL graph** for the **concept graph**. The **RaUL graph** is mapped to a Web form.

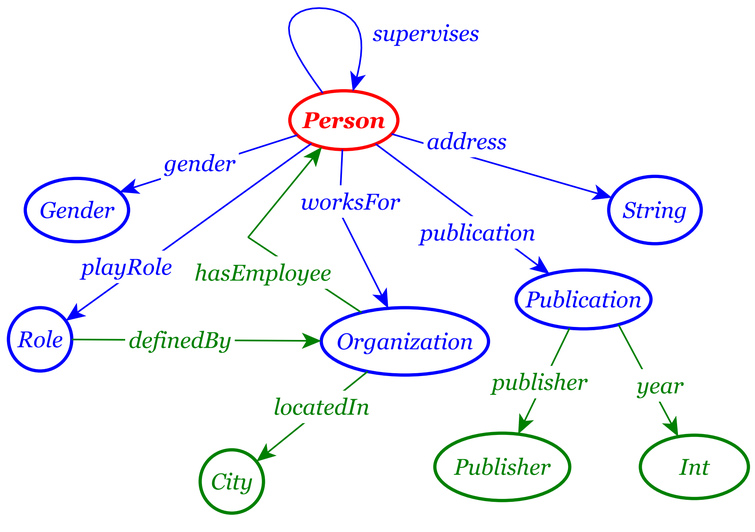
Concept Graph

Concept Graph CG(ν): A directed graph $CG(\nu) = < U, E, \nu >$ where ν is the `concept node` and $\forall\ u \in U$, there exists a path $\overset{\nu \rightsquigarrow u}{\pi}$ of length l between ν and u.

Constructing a Concept Graph CG(ν): In the **ontology** relationships amongs concepts are model through different **physical models** using RDFS and/or OWL modeling languages. The example physical models for "`Person worksFor Organization`" relation are shown.

- We adopt a **breadth first** approach to incrementally extract **associations** (relationships) of different lengths for the `concept node` modeled through different physical models.
- For the **Person** class of an example ontology, we extract associations of length $l = 1,2,\ldots,n$. Where 'n' is maximum length of any association for Person.

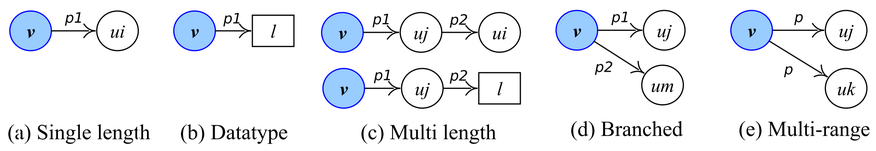




RaUL Web Form

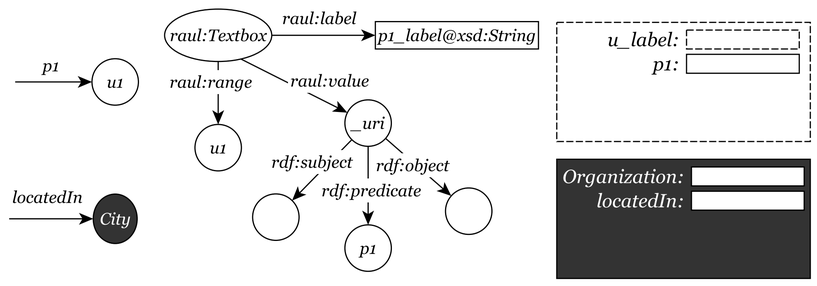
RaUL Graph μ(ν): is RaUL based mappings for CG(ν), where for all unique $\overset{\nu \rightsquigarrow u}{\pi} \in$ CG(ν) a mapping $\mu : \overset{\nu \rightsquigarrow u}{\pi} \rightarrow$ RaUL is one or more valid RaUL widget elements for $\overset{\nu \rightsquigarrow u}{\pi}$.

Mapping the Concept Graph CG(ν) to a RaUL Graph: Befor mapping to a RaUL graph, some **cycles** and **redundant associations** are removed from the concept graph. **Base property paths** (shown below) are identified that alone or together compose an association in any concept graph. A **RaUL mapping** is defined for each of the base property path.

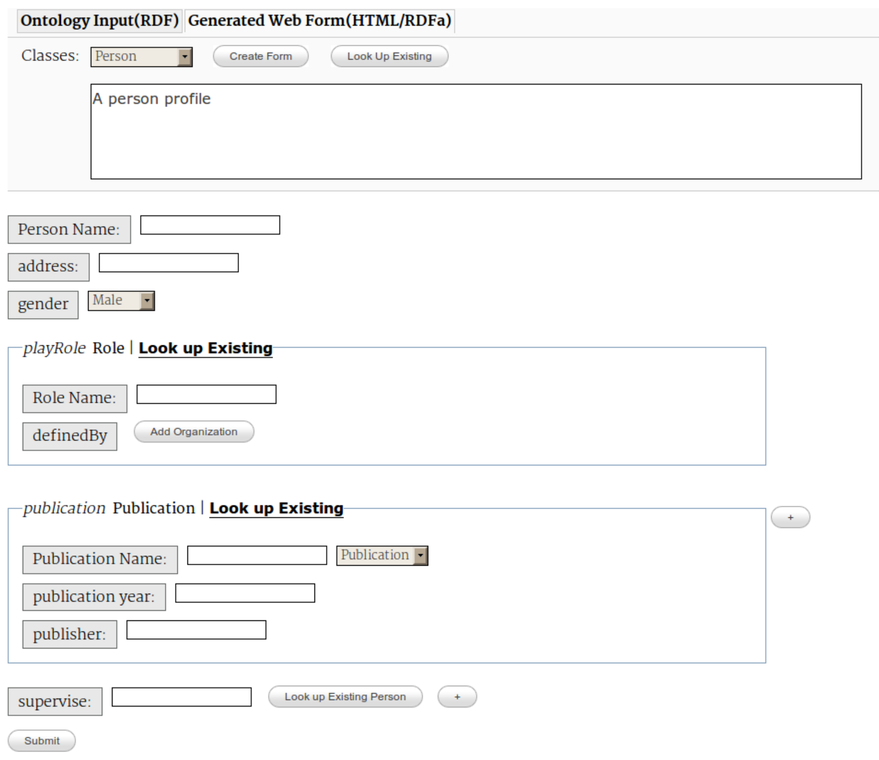


(a) Single length (b) Datatype (c) Multi length (d) Branched (e) Multi-range

Each association is mapped to the corresponding RaUL mapping/s based on its type of property paths. Each RaUL mapping is then mapped to a Web form element.



Example Web Form



Evaluation

We validate our approach in a user study based on use cases developed by the W3C Semantic Sensor Network (SSN) Incubator group. The users created RDF data based on the SSN ontology with **ActiveRaUL** generated user interfaces and **WebProtege**. They then rated **ActiveRaUL** compared to **WebProtege** for the **creation of RDF data** on a System Usability Scale (SUS).
An Average rating for both the systems on **SUS** is shown here:

Summary of results:

- **Correctness:** ActiveRaUL 91% vs WebProtege 82% .
- **Efficiency:** ActiveRaUL between 27% to 56% faster than WebProtege.
- **Satisfaction:** ActiveRaUL 72.1/100 compared to WebProtege 32.5/100 SUS rating