Design and Implementation of a Diagrammatic Tool for Creating RDF graphs

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Where am I from?

Babeș-Bolyai University of Cluj-Napoca, Romania

- largest and highest ranked University in Romania
- biggest city in Transylvania and friendliest city for foreigners

- **Business Informatics Research Center** Research topics:
  - Knowledge Management Systems
  - Business Process Management
  - Distributed Systems

Agenda

- Goal & Motivation
- Background on RDF
- Background on AMME & ADOxx
- Proposed Tool & Implementation Details
- Related Works
- Conclusions & Outlook

Goal statement

- Present a modeling tool customized for creating Resource Description Framework (RDF) graphs, by integrating notions of:
  - Conceptual Modeling
  - Agile Modeling Method Engineering (AMME) framework (ADOxx for implementation)
    - Model-driven code generation paradigm

=> a starting point to develop an OMiLAB project.

Goal Statement

- We propose the notion of **TSML** (Technology-specific Modelling Language) as a flavor of DSML (Domain-specific Modelling Languages)
  - DSML = domain-specific concepts and properties become first-class modelling citizens (rather than interpretations on generic concepts)
  - Similarly, TMSL aims to assimilate **technology-specific** concepts/properties:
    - For what purpose? **Code generation for technology-specific platforms**

In our case, the target technological space is RDF*
(the **Resource Description Framework**)

*see https://www.w3.org/RDF/

Our means of realizing Technology-specific Modelling Tools:
Agile Modelling Method Engineering (AMME)

Motivation

Goal: Resolve fundamental enterprise-level issues regarding the production of knowledge graphs by:

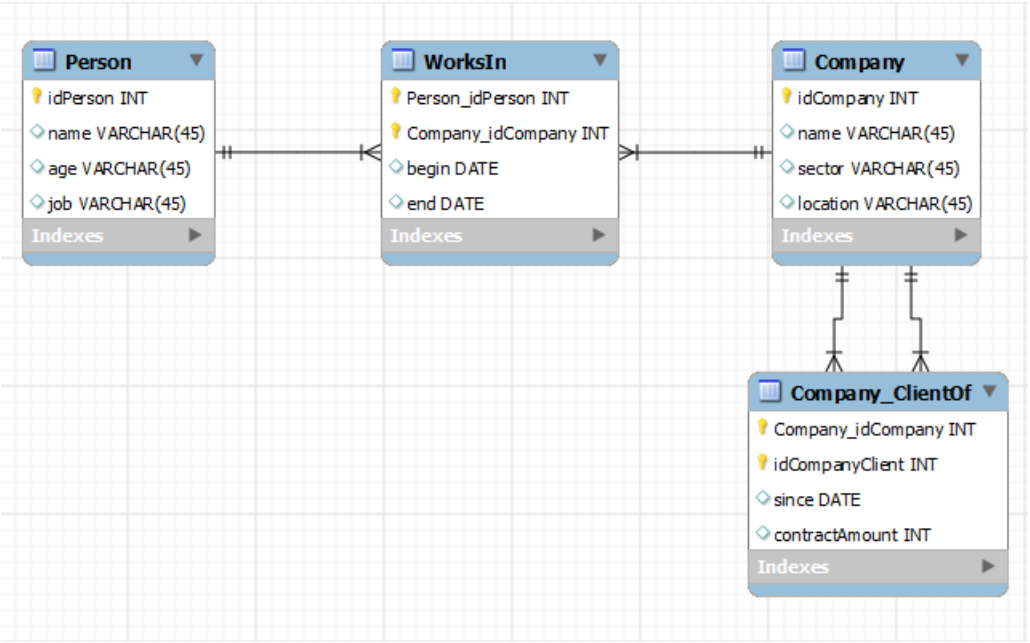
- Minimizing the effort of RDF data creation
- Easily incorporate additional functionality if needed (AMME-driven)
- Generate machine-readable knowledge graphs out of diagrammatic structures

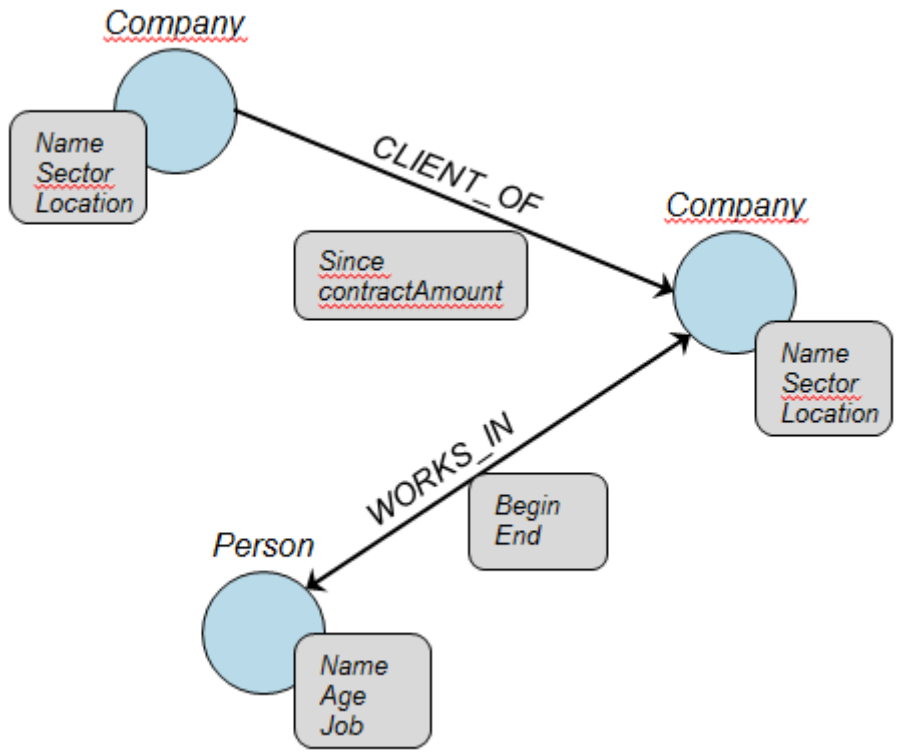
Why RDF?

- It is the underlying technology for the **Linked Enterprise Data** paradigm*
- The data model **is more flexible** than traditional relational databases
- Easily manages **many-to-many relationships**
- Supports **schemaless graph databases** (data can be created before deciding on a schema)
- Supports **knowledge representation and reasoning use cases**

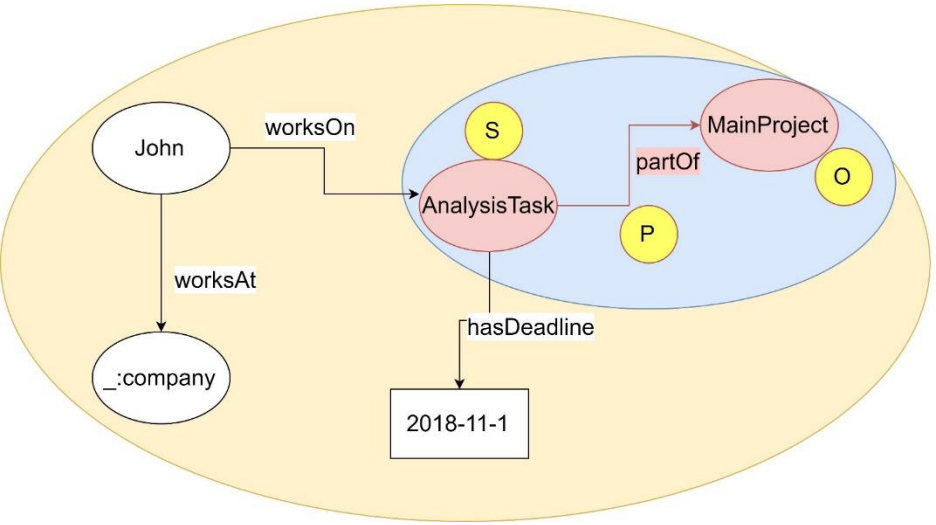
*see Wood, D., Linked Enterprise Data, Springer, 2010

Modelling data as a graph





Background on RDF data graphs



N-triples serialization syntax

Prefix: http://ratiu.ro#

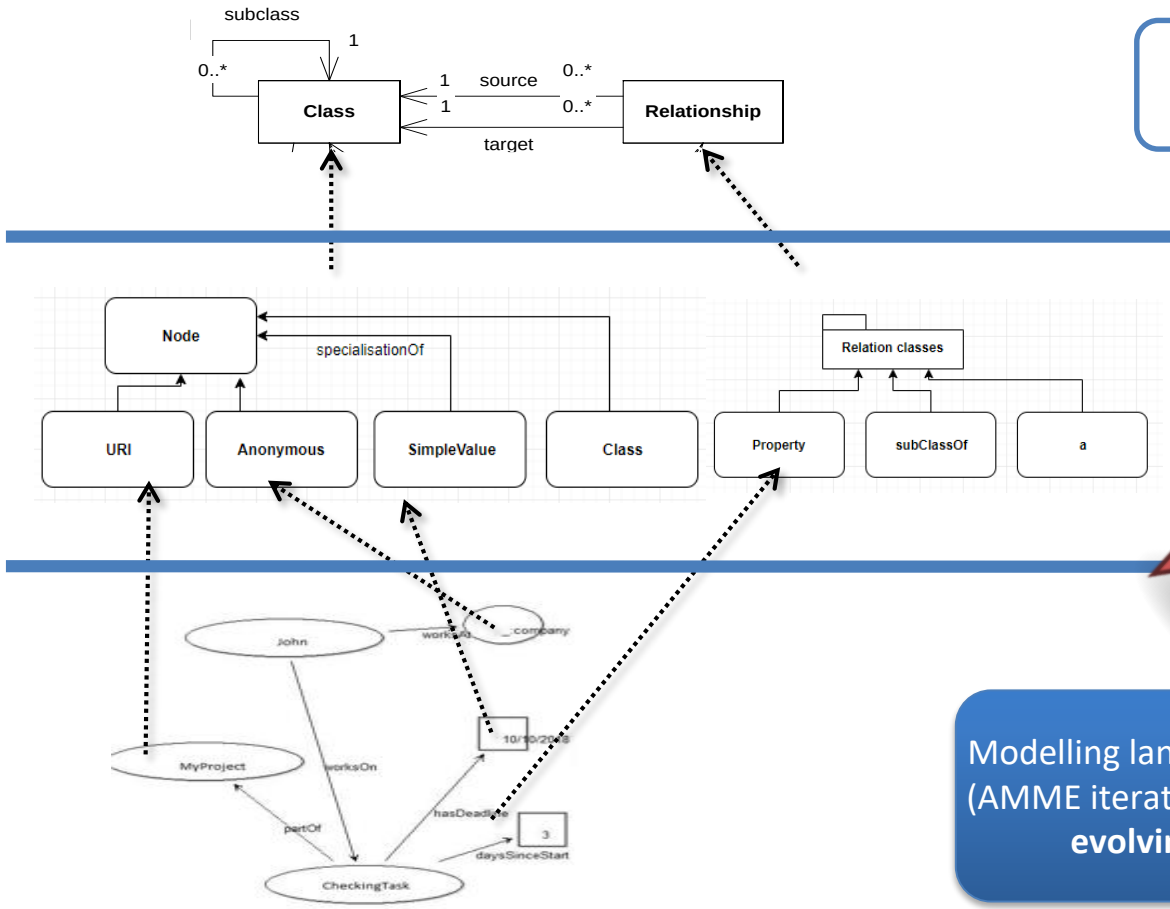
<http://ratiu.ro#John> <http://ratiu.ro#worksAt> _:company.

<http://ratiu.ro#John> <http://ratiu.ro#worksOn> <http://ratiu.ro#AnalysisTask>.

<http://ratiu.ro#AnalysisTask> <http://ratiu.ro#hasDeadline> "2018-11-1"^^<http://www.w3.org/XMLSchema#date>.

<http://ratiu.ro#AnalysysTask> <http://ratiu.ro#partOf> <http://ratiu.ro#MainProject>.

Background on Agile Modelling Method Engineering*



META-META LAYER

The (fixed) concepts that can be used to agilely tailor modelling languages (metamodels)

META LAYER

The Metamodel underlying the RDF formal semantics

Modelling language increments (AMME iterations necessary for **evolving the tool**)

MODELS LAYER

The RDF knowledge graphs

* cf. Karagiannis, D. (2015). "Agile modelling method engineering" In: *Proceedings of the 19th Panhellenic Conf. on Informatics*. Ed. by N. Karanikolas, D. Akoumianakis, N. Mara, D. Vergados, X. Michalis, ACM, p. 5-10.

How ADOxx was employed

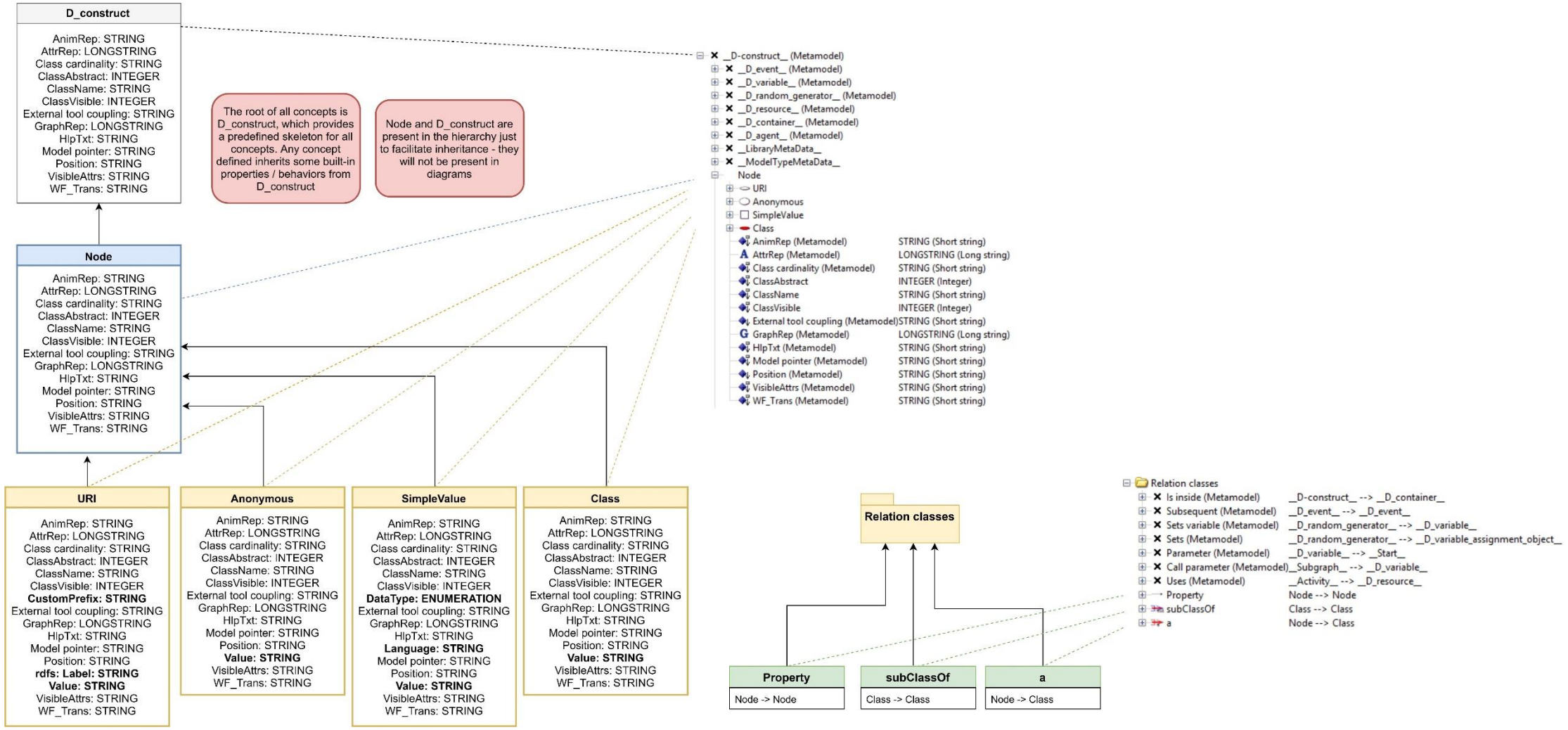
- Allows the implementation of a modeling language notation, grammar and vocabulary

=> Our tool enables the creation of RDF graphs by visual means

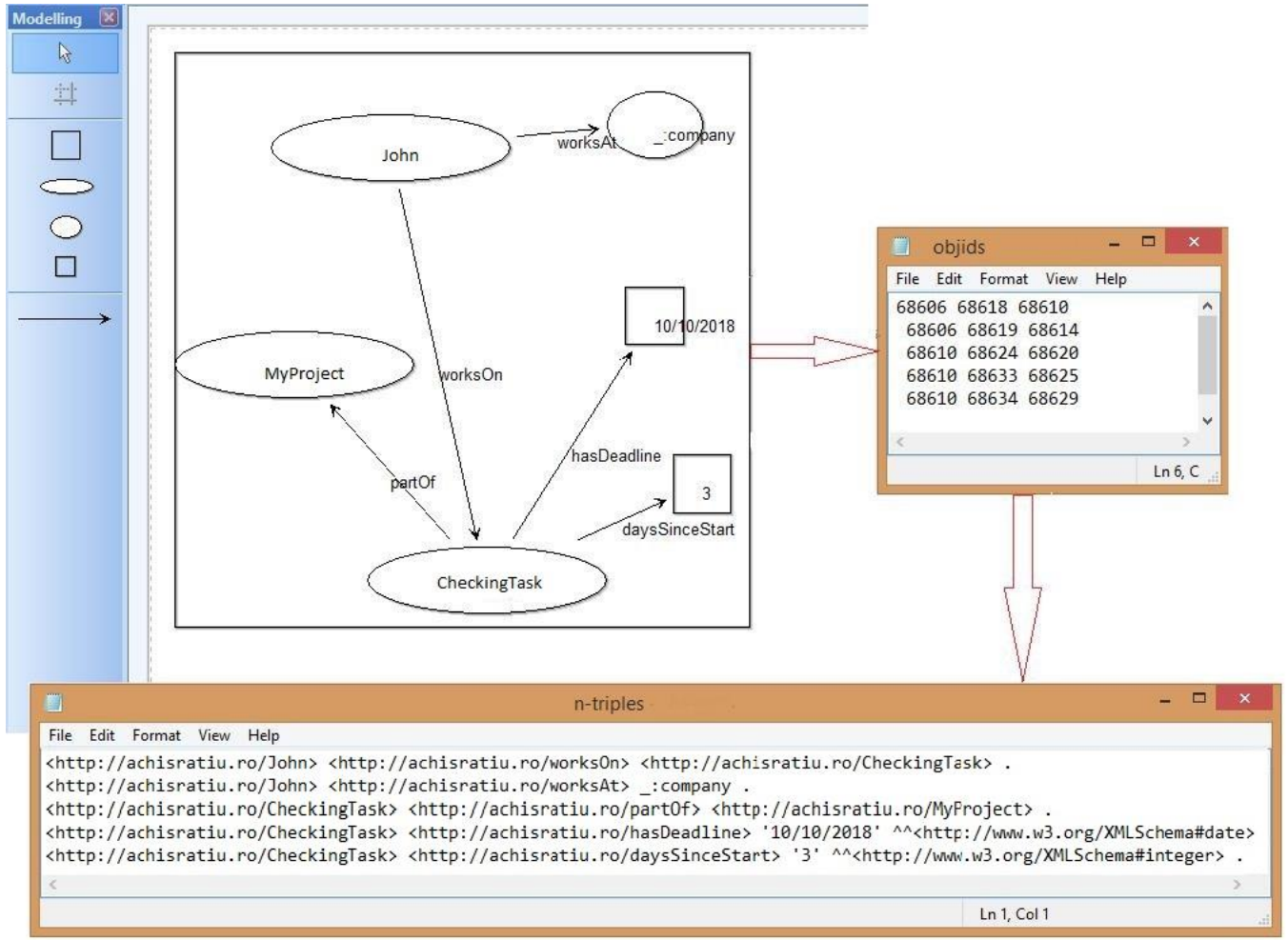
- Internal scripting language allows the implementation of model-based functionality

=> Our tool generates N-triples serializations from the visual structures

Proposed Modelling Language: Metamodel



Proof-of-concept: Model Example



ADOxx Script script sample for generating N-triples

```
PROCEDURE TRANSFORM_URI input:integer output:reference
{

GET_GRAPHPREFIX graphinput:(modelid) graphoutput:prefix

CC "Core" GET_ATTR_VAL objid:(input) attrname:"Value"

SET uri:(prefix + val)

SET soutput:(uri)

}
```

1

transform from object id to specific N-triples syntax, the URI is formed of graph prefix + object value.

```
CC "Core" GET_CLASS_ID classname:"URI"
SET uriclassid:(classid)
```

2

store the URI class id as we need it further when looping through the array of object ids

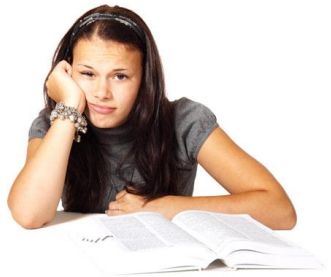
```
FOR i in:(objids)
{

CC "Core" GET_CLASS_ID objid:(VAL(i))

SET selectedclassid:(classid)

IF(selectedclassid = uriclassid)
{

        TRANSFORM_URI input:(VAL(i)) output:uri

        CC "AdoScript" FWRITE file: "...n-triples.txt" text:(uri)
}
```

3

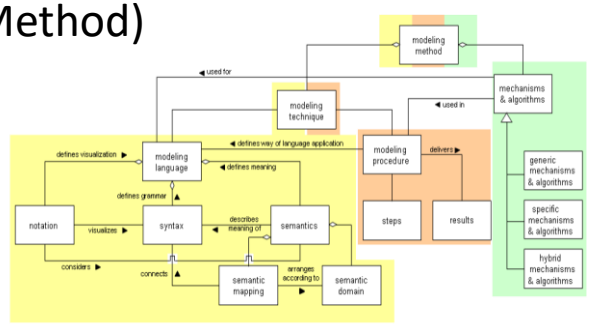
loop through the array of object ids and when found an URI object type, execute procedure, and afterwards the output will be written to n-triples.txt

Development method

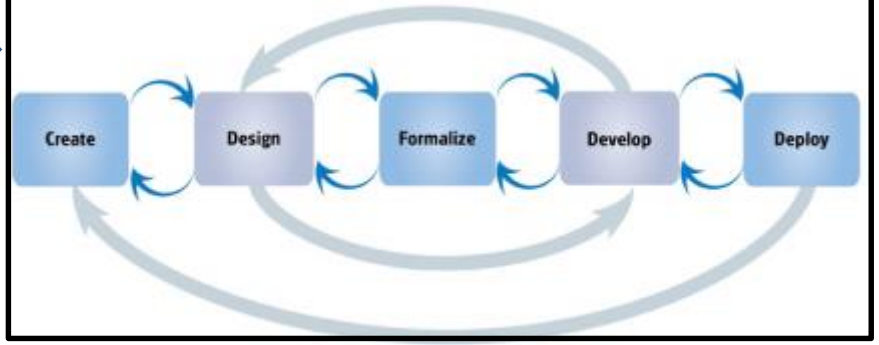
Phase 1. ADOxx implementation exercise
(guided by the requirement to support basic RDF editing)



Phase 2. Abstraction exercise
(how the results illustrate the abstract notion of Modelling Method)



Phase 3. AMME lifecycle
(iterations for improvement and extension driven by additive requirements)



Phase 4. Opening the tool as OMiLAB project
(TBD)

OMiLAB® Global Network

Related Work and Proposed Benefits

Some other tools that have been developed during recent times for RDF processing:

- TopBraid Composer
- Callimachus
- Protégé
- RDF Studio

However, such tools provide **plug-ins for visualization of already created graphs**, rather than the possibility of creating RDF with a modelling look&feel

Recent tool closer to our goals: OWLGrEd (http://owlgred.lumii.lv/)

However, we aim for an open source tool that can be easily evolved by anyone cf. the OMiLAB philosophy and AMME's iterative nature

Conclusions

- This tool contributes to research related to the implementation of RDF modeling tools
- RDF graphs should be created as easily as filling data in SQL tables, even in the absence of a schema

=> potential impact in the Linked Enterprise Data area with respect to usability of knowledge graph creation

Outlook: To further evolve the tool towards an ontology design environment

Thank you!

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