

# A Community-driven Approach to Development of an Ontology-based Application Management Framework

Marut Buranarach, Ye Myat Thein, Thepchai Supnithi  
Language and Semantic Technology Lab (LST), NECTEC, Thailand  
{marut.bur, thepchai.sup}@nectec.or.th, yemyatthein@gmail.com}

*Published in: H. Takeda et al. (Eds.): JIST 2012, LNCS 7774,  
Springer-Verlag Berlin Heidelberg, pp. 306–312, 2013.*



# Outline

- Introduction
  - Motivation
  - Overview of OAM Framework
- Architecture of OAM Framework
- A Community-driven Approach to Software Tool Development
- Case Study: Activity recognition task in smart home domain (a JAIST project)
- Discussions

# Motivation

- The semantic web standards, i.e., RDF, SPARQL, OWL, have already been established.
- However, applications and uses of the semantic web data are relatively limited.
- This is partly due to high learning curve and efforts demanded in building semantic web and ontology-based applications.

# Motivation (2)

- To facilitate development of semantic web and ontology-based applications, we believe that development tools should not only be designed for technologists but also researchers or domain experts who are non-technology experts.
  - User can focus on domain problems and knowledge rather than implementation details.

# Overview of OAM Framework

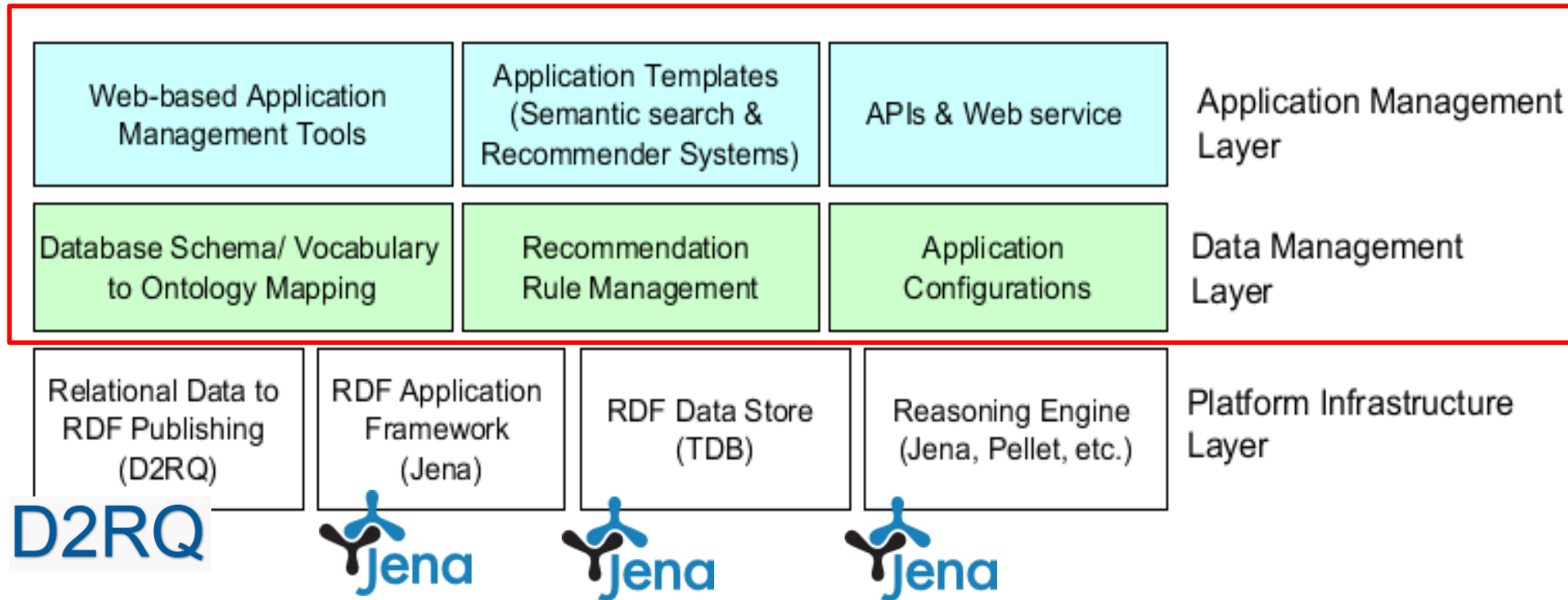
- The Ontology-based Application Management (OAM) framework is a development platform for simplifying creation and adoption of a semantic web and ontology-based application.
- The framework is primarily built on top of some existing tools and frameworks, i.e., the Jena framework and D2RQ.

# Overview of OAM Framework (2)

- Integrated tool that supports both RDF data publishing from databases and processing of the RDF data in ontology-based applications, i.e.
  - Semantic search application
  - Recommender system application
- Provides application templates that can process the RDF data.
  - With application templates, user does not need programming skill in building an application.

# Architecture of OAM Framework

## OAM Framework



# Architecture of OAM Framework (2)

- Implemented on top of existing semantic web data and application platform
  - i.e., Jena, D2RQ, RDF data storage, reasoner
- Added some data and application management functions, i.e.,
  - Database schema/vocabulary to ontology mapping
  - Recommendation rule and application configuration management
  - Application templates
  - APIs and Web service interfaces to support a more advanced application development



# Some OAM functions

- Database Schema and Vocabulary to Ontology Mapping Management
- Recommendation Rule Management
- Application Templates

# Database Schema and Vocabulary to Ontology Mapping Management

- Supports both schema mapping and vocabulary mapping between OWL ontology and a relational database source.
- User can define mapping between ontology classes and database tables.
  - Class-table mapping
  - Property-column mapping
  - Vocabulary mapping
- Vocabulary mapping allows synonymous terms to be mapped with a class in ontology that would allow semantic-based processing in applications.

# Recommendation Rule Management

- To simplify creation and management of recommendation rules by hiding complexity of the rule syntax.
- Allows creating recommendation
  - e.g., a recommendation “car models with Japanese brand and priced under \$20,000”.
- Allows linking recommendation
  - conditions of class instances to which the recommendation is assigned
  - e.g., customer instances that match a condition of “young adults with Asian nationality”.

## Recommendation Rule Management (2)

- The tool facilitates the user to create such business logics using a form-based user interface.
- The rules would then be converted to the rule syntax for a reasoner, i.e. Jena's

```
[Create_car_rec_1: (?x rdf:type ns:CarModel) (?x ns:has_brand ?y) (?y rdf:type ns:JapaneseBrand)
                  (?x ns:has_price ?z) lessThan(?z, 20000) -> (comp1:car_rec_1 rdf:type ns:CarRecommend)
                  (comp1:car_rec_1 ns:has_rec_id '1') (comp1:car_rec_1 ns:has_car_model ?x)]

[Link_car_rec_1:  (?x rdf:type ns:Customer) (?x ns:has_nation ?y) (?y rdf:type ns:Asian)
                  (?x ns:has_age_group ?z) (?z rdf:type ns:YoungAdult) (?a rdf:type ns:CarRecommend)
                  (?a ns:has_rec_id '1') -> (?x ns:has_car_model_recommendation ?a)]
```

# Application Templates

- With application template, the user only needs to define application configuration and does not need programming skill in building an application.
  - Suitable for researchers who want to experiment on research ideas that can be realized by means of the semantic web technology.
  - Typically ideal for rapid prototyping and hypotheses testing.

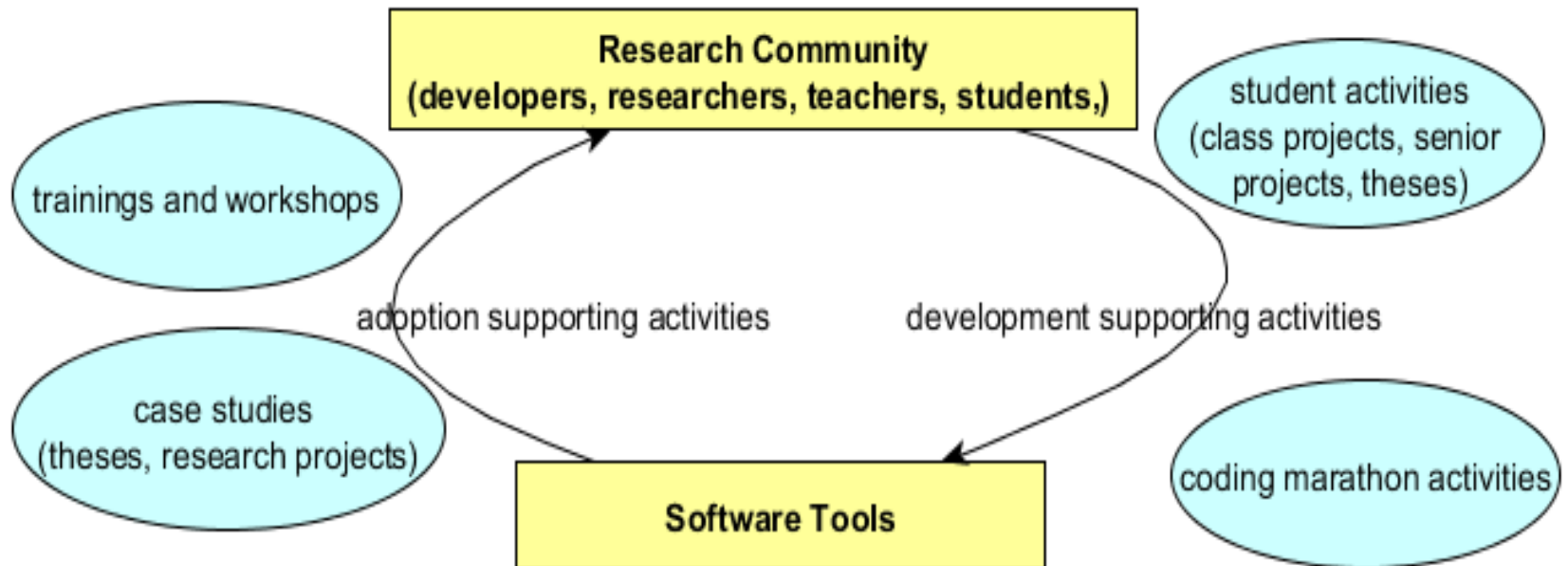
# Application Templates (2)

- Currently, two application templates are provided:
  - semantic search application
  - recommender system application
- The semantic search application template provides a faceted search interface.
- The user's faceted search condition is automatically transformed to a SPARQL query for retrieving the instance data from an RDF database.

# Development of OAM Software Tool

- A Semantic Web research community (interest group) in Thailand has contributed to evolution of the OAM software tool.
  - Interested Users, Software Developers, Researchers, University Teachers & Students
- OAM is currently adopted only within the community.
- OAM is co-developed by the community.

# A Community-driven Approach to Software Tool Development





# Adoption Supporting Activities

- In supporting tool adoption, training and workshop activities can be organized to introduce the tool to the research community.
- In addition, some case studies are needed to demonstrate application potentials of the tool.
- The community users who adopted the tool can help to provide feedbacks, testing and evaluation results, which can contribute to gathering additional requirements for improving the tool.

# Development Supporting Activities

- In supporting tool development, university teachers can integrate some parts of the tool development as student assignments for class projects, senior projects or theses.
- In addition, coding marathon activity, which is popularly adopted in opensource software development, can be organized to promote collaborative efforts in improving design and implementation of the tool.

# Our Experience

- We have conducted user training sessions to introduce the tools to the community.
  - Workshop on ontology development using Hozo ontology editor
  - Workshop on ontology application development using OAM
- Feedbacks from the participated users, were gathered as user requirements to guide the tool improvement.



# Our Experience (2)

- In addition, some university teachers have taken these requirements and assigned them as class and senior projects for their students.
- We also organized a coding marathon activity which helped to improve the tool both in terms of functionalities and user interface designs.
  - Collaborative design and coding

# Our Experience (3)



Coding marathon activity, December 2010

# Case Study

- In a recent project, OAM was used to support human activity recognition task in smart home domain.
  - The ontology was created using Hozo editor.
- The ontology-database mapping tool helped to simplify mapping process between the domain ontology and the database storing the sensor-based data.
  - It then transformed the data to the RDF format.

## Case study (2)

- The recommendation rule management component helped to facilitate defining rules for the human activity recognition task.
- The semantic search application template allows for rapid prototyping and evaluating the recommendation results.



## Example use of the application framework for activity recognition task in smart home domain.

Properties of **Sensor**:

DATATYPE PROPERTY: **has\_Status** COLUMN: **Status** **status**

☐ Datatype Property Mapping ☒ Object Property

Property **has\_AttachTo**

Property Range **Object**

From Table **sensorid**

To Table **objectid**

Foreign Key **AttachTo**

Property Label **sensor object**

**Save** **Cancel**

has_have_hum_po:	<ISA>		Sit
has_have_obj	<ISA>		TV
has_have_obj	<ISA>		Sofa

Watching TV

- Recommended to **Context** with this condition: has have\_obj <ISA> TV; has have\_obj <ISA> Sofa; has have\_hum\_pos <ISA> Sit;

Watching TV

- Recommended to **Context** with this condition: has have\_obj <ISA> TV; has have\_obj <ISA> Sofa; has have\_hum\_pos <ISA> Lie-down;

Sweep the floor

- Recommended to **Context** with this condition: has have\_obj <ISA> Broom; has have\_hum\_pos <ISA> Stand;

### Ontology-Database Mapping

### Recommendation Rule Management

Path ▾ **Context**

has\_have\_date ▾ Contains ▾ 4112012

### Semantic Search Application Template

context id	context date	context time	sensor id	object name	posture name	has_have_inf.
4112012		1030	4, 17, 5	Human, Sofa, TV	Sit	Watching TV
4112012		1050	4, 13, 5, 15	Human, Computer, Sofa, Chair	Lie-down	Lying down & relaxing
4112012		800	5, 9	Human, Bed	Lie-down	Sleeping



# Case Study Papers

- Activity Recognition using Context-Aware Infrastructure Ontology in Smart Home Domain, (KICSS2012)
  - Konlakorn Wongpatikaseree, Mitsuru Ikeda, Marut Buranarach, Thepchai Supnithi, Azman Osman Lim and Yasuo Tan
- Location-based Concept in Activity Log Ontology for Activity Recognition in Smart Home Domain (JIST2012)
  - Konlakorn Wongpatikaseree, Mitsuru Ikeda, Marut Buranarach, Thepchai Supnithi, Azman Osman Lim and Yasuo Tan
  - **“Best In-Use Track Paper Award”**



# Discussions

- In this paper, we introduce OAM, an application framework aimed to simplify development of ontology-based applications based on the semantic web technology.
- Our tool development approach relied significantly on contributions from the research community.

## Discussions (2)

- Based on download statistics in 2012 (8 months), OAM has approximately 45 downloads monthly.
  - URL: <http://text.hlt.nectec.or.th/ontology/>
- Some future development includes:
  - add support for more application templates
  - improve compatibility with other ontology tools
  - adding support for Linked data interoperability

# Acknowledgement

- This work was partially supported by the Service Informatics (SI) program at National Science and Technology Development Agency (NSTDA), Thailand.
- The authors would like to thank all the contributors to the tool development and adoption.