A Semantic Web Ontology for Research Community

Oct. 25, 2006

In-Su Kang, Hanmin Jung, Seungwoo Lee, Pyung Kim, Heekwan Koo, Mikyoung Lee, Namang Kuh, Won-Kyung Sung

Korea Institute of Science and Technology Information

Information System Research Laboratory

Contents

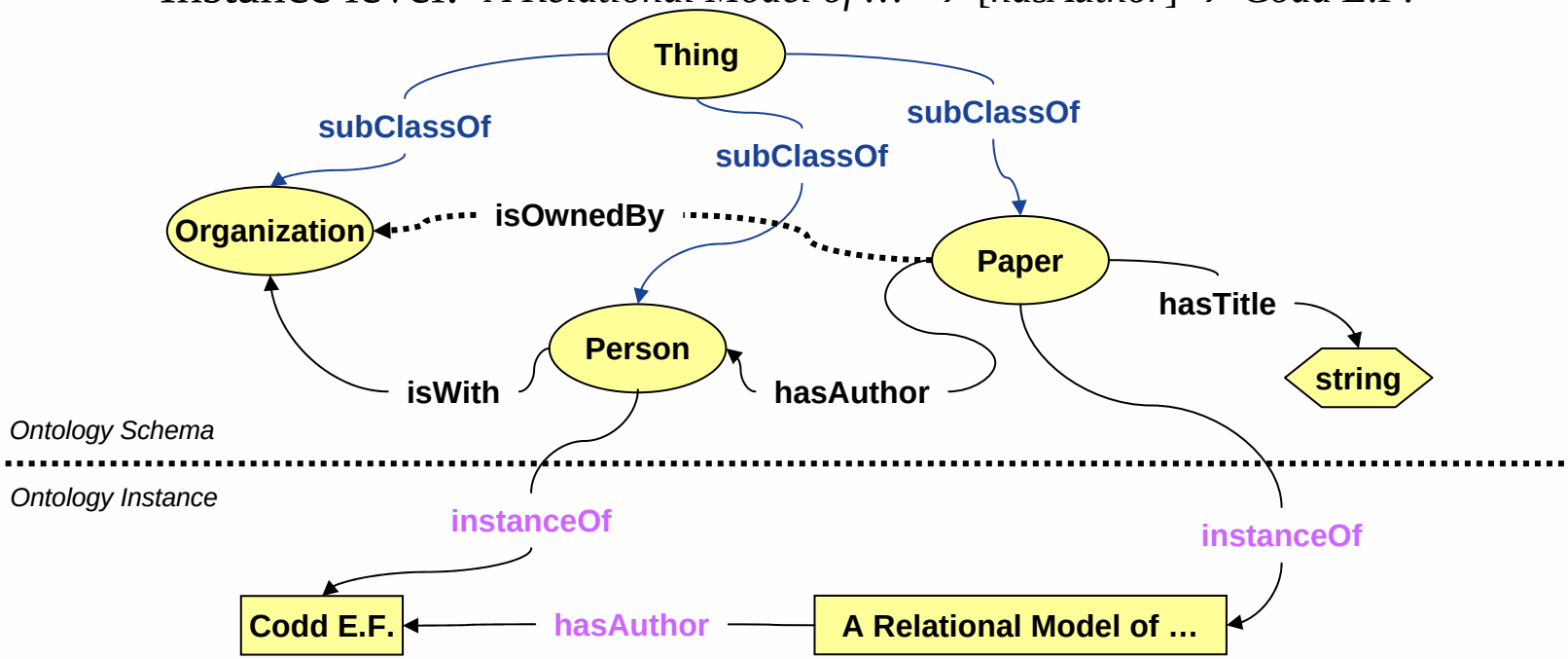
- **Introduction**
  - Semantic web & ontology
- **Previous works**
  - Ontology development methodology
  - Ontology for research community
- **OFK ontology (for research community)**
  - Ontology schema
  - Ontology instance
  - Instance management by URI-server
  - Instance representation
- **Construction of OFK ontology**
- **Conclusion**

Introduction - background

- **Current web**
  - Human-oriented, syntactic
    - Only understood by persons
    - Disallow automatic processing
- **Semantic web** **[Berners-Lee et al., 2001]**
  - Machine-oriented, semantic
    - Semantic tags assigned to information units
  - Prerequisite
    - Ontology
      - concept hierarchy for semantic tagging
    - Inference engine
      - ontology validation & implicit knowledge extraction

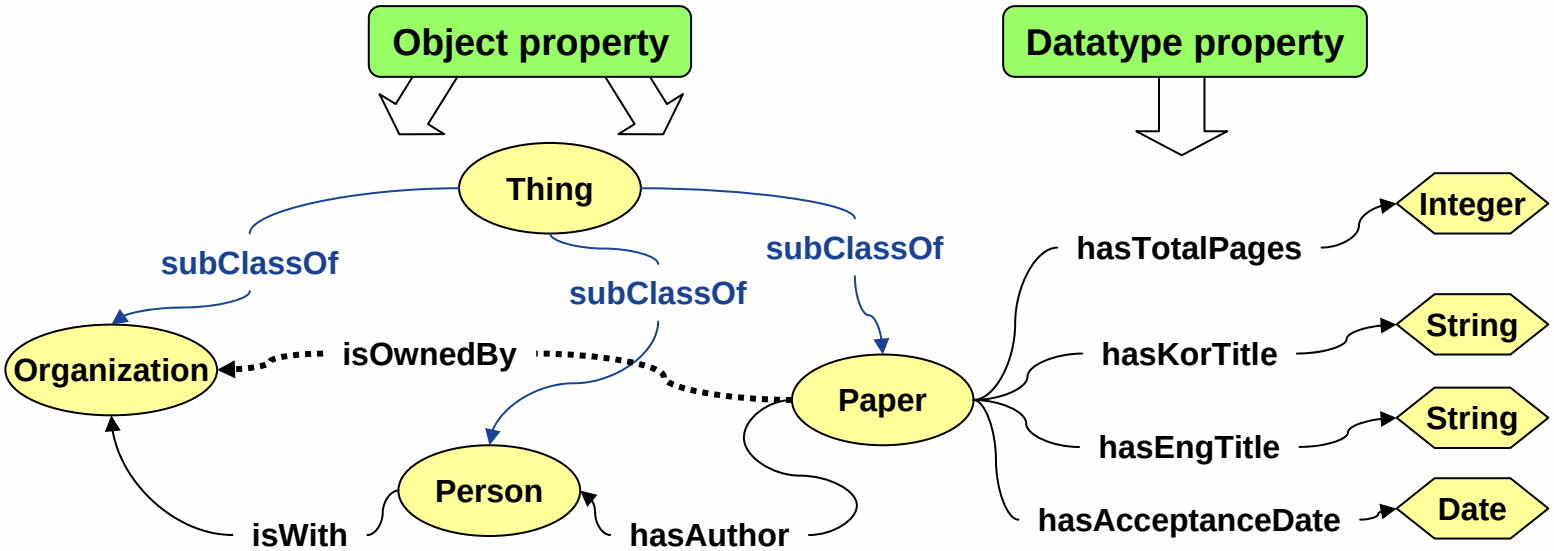
Introduction - ontology (1/2)

- **Shared, formal, explicit conceptualization** [Gruber'93, Borst'97]
  - for concepts and relationships b/w concepts
- **Two dimensions**
  - Schema level: [*Paper*] → [*hasAuthor*] → [*Person*]
  - Instance level: *'A Relational Model of …'* → [*hasAuthor*] → *'Codd E.F.'*



Introduction - ontology (2/2)

- **Relationship b/w concepts**
  - Object property
    - Relationship b/w concepts
    - Similar to relationship b/w entities in RDB
  - Datatype property
    - Relationship b/w concept and literal
    - Similar to relationship b/w an entity and an attribute in RDB



Previous works - ontology development methodology

- **Focused on schema modeling**
  - Uschold and King's method (1995), Grüninger and Fox's method (1995), KACTUS-based method (1996), SENSUS-based (1997), METHONTOLOGY (1999), On-To-Knowledge method (2001)
- **Need for instance modeling**
  - Identification system
    - (e.g.) SSN for persons, DOI for contents
  - Identity resolution
    - Synonymy problem
      - (e.g.) John R. Smith vs. John Richard Smith
    - Homonymy problem
      - (e.g.) John R. Smith in Harvard Univ. vs. John R. Smith at MIT

Previous works – ontology for research community

- **Research area ontologies**
  - KA2 ontology [Benjamins, 1999]
    - Modeling knowledge acquisition community (researchers, topics, etc.)
    - The first ontology for research area
  - SWRC (Semantic Web Resource Community) ontology [Sure et al., 2005]
    - KA2-based
    - Applied to creating social networks of researchers
  - AKT reference ontology [http://www.aktors.org/publications/ontology/]
    - English AKT project (2000. Oct. ~)
    - Inferring top-level researchers / organizations / researcher's cluster
- **Summary**
  - Includes *Person*, *Organization*, *Project*, *Publication* in common
  - Does not address identity resolution for instance modeling (except AKT case)
    - (e.g.) ambiguity of same-name authors

OFK ontology - overview

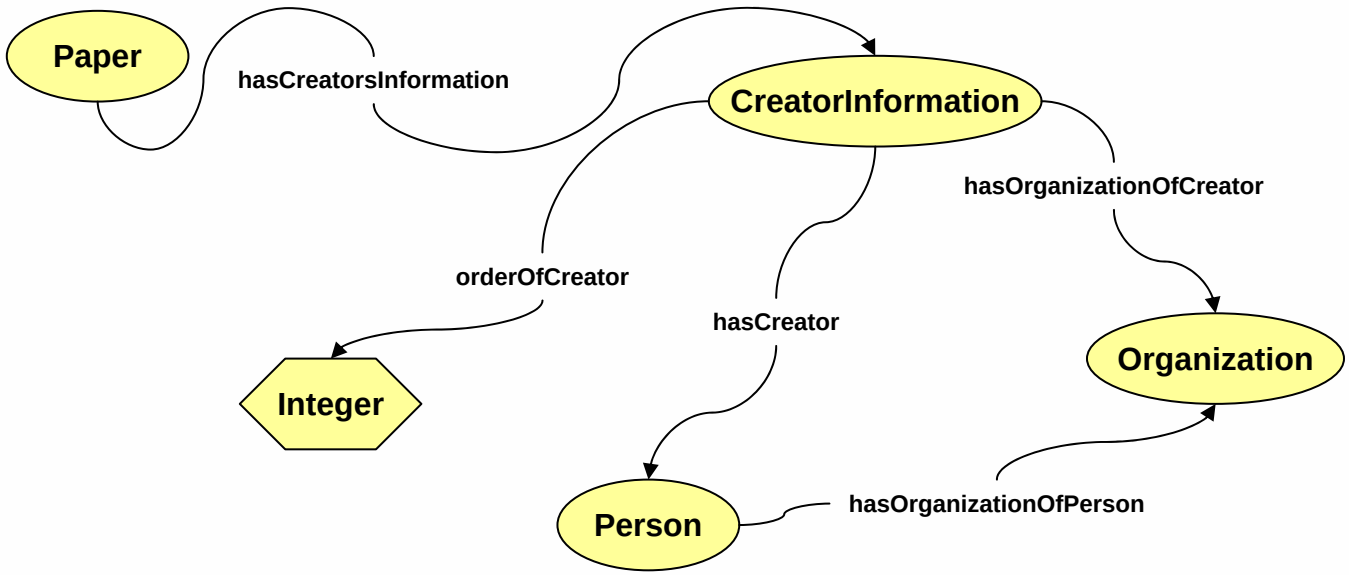
- **Motivation**
  - Support researchers over full life-cycle of research activity
  - OFK: OntoFrame-K®(ver. 2006)
    - Ontology framework for Knowledge/Korean/KISTI
- **Design principles**
  - Schema-level
    - Language-independent
    - Scenario-oriented
      - Do not include unnecessary elements from the viewpoint of application
    - Ockham's razor
      - Do not represent properties derivable from rules
  - Instance-level
    - Separate management of instances
      - Through URI-server
        - Instance storing
        - Instance identity management
        - Integrity check

OFK ontology – schema (1/2)

- **Core classes**
  - Person, Organization, Project, Outcomes (Paper, Patent, Report), Publication (Journal, Proceedings), Topic, CreatorsInformation, Location
- **Object property**
  - Outcomes – hasCreatorsInformation – CreatorsInformation
  - Outcomes – hasOriginatedProject – Project
  - Outcomes – hasPublication – Publication
  - Outcomes – hasTopic – Topic
  - CreatorsInformation – hasCreator – Person
  - CreatorsInformation – hasOrganizationOfCreator – Organization
  - Project – hasOrganizationOfFundingProject – Organization
  - Project – hasOrganizationOfPerformingProject – Organization
  - Organization – hasLocation – Location
  - Person – hasOrganizationOfPerson - Organization

OFK ontology – schema (2/2)

- **CreatorsInformation**
  - Info. of a creator at the time when his/her outcome was written
    - Order of creator
    - Person corresponding to a creator
    - Organization of a creator
      - Different from organization of person



OFK ontology – instance

- **Identification system**
  - Outcomes
    - KOI (Knowledge Object Identifier)
      - Proceedings paper: ‘KISTI1.PCD.0001234’
      - Journal paper: ‘KISTI1.JNL.0000123’
      - Patent: ‘KISTI1.PTN.0000012’
      - Report: ‘KISTI1.RPT.0012345’
  - Person
    - National Science & Tech. Personnel Identification system
      - 10-digit unique number
      - (e.g.) Clinton: ‘7010862430’
  - Organization
    - Organization code compiled by Korea Research Foundation
      - 6-alphanumeric code
      - (e.g.) Seoul National Univ.: ‘114800’
      - (e.g.) Korea Institute of Science and Tech. Info. : ‘9R9048’

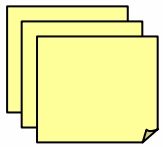
OFK ontology – instance management

Extraction of Bibliographic Information

◇ **Format check**

◇ **Field constraint check**

◇ **URI assignment**



Documents

Title: A Storage Structure for Nested Relations Using Signatures

Author: Hwan-Seung Yong, Sukho Lee

Publication: Journal of Systems Architecture

Volume(Issue)/Page: 43(5) / 245-250

Year: 1997

Sukho Lee → PER_4410022529

Jnl. of Sys. Arch. → PUB_SOJ000574

…

Register to URI-sever

(referential integrity check)

(duplicate check)

Generation of ontology instance

URI Server Data

URI	Type	Metadata
PER_4410022529	Person	Name: Sukho Lee, Organization: ORG_114800
PER_0000012345	Person	Name: Hwan-Seung Yong, Organization: ORG_133600
OBJ_KISTI1.JNL.0000001	Outcomes	Title: A Storage Structure for Nested Relations Using Signatures Publication: PUB_SOJ000574, Year: 1997, Volume(Issue): 43(5), Page:245-250
ORG_114800	Organization	Name: Seoul National University
ORG_9R9048	Organization	Name: **Ewha Womans University**
PUB:SOJ000574	Publication	Name: Journal of Systems Architecture
TOP_030213	Topic	Topic name: database

OFK ontology – instance representation

Title: A Storage Structure for Nested Relations Using Signatures

Author: Hwan-Seung Yong, Sukho Lee

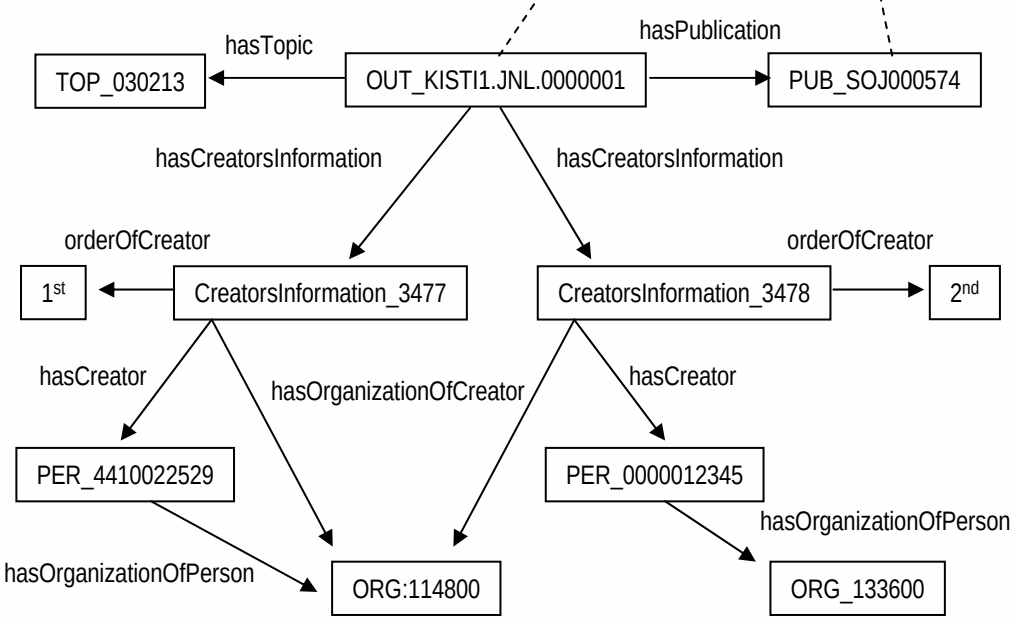
Publication: Journal of Systems Architecture

Volume(Issue)/Page: 43(5) / 245-250

Year: 1997

URI Server Data

URI	Type	Metadata
PER_4410022529	Person	Name: Sukho Lee, Organization: ORG_114800
PER_0000012345	Person	Name: Hwan-Seung Yong, Organization: ORG_133600
OBJ_KISTI1.JNL.0000001	Outcomes	Title: A Storage Structure for Nested Relations Using Signatures Publication: PUB_SOJ000574, Year: 1997, Volume(Issue): 43(5), Page:245-250
ORG_114800	Organization	Name: Seoul National University
ORG_9R9048	Organization	Name: **Ewha Womans University**
PUB_SOJ000574	Publication	Name: Journal of Systems Architecture
TOP_030213	Topic	Topic name: database



Information System Research Laboratory

Construction of OFK ontology - schema

- **Statistics**
  - # of classes: 21
  - # of properties: 64
    - # of datatype properties: 46
    - # of object properties: 18
  - # of rules: 22
    - # of object properties derived by rules: 14
- **Ontology creation**
  - Ontology editing tool
    - Protégé 3.1.1
  - Ontology description language
    - W3C OWL DL (http://www.w3c.org/)

Construction of OFK ontology - instance

- **Target bibliographic data**
  - Proceedings of major conferences/workshops/symposiums
    - Held at Korea during 2002 through 2006
    - # of papers: 12,016
- **# of RDF (Resource Description Framework) triples**

Type		# of RDF Triples
Class instance (105,479)	Person	11,390
	Outcomes (Paper)	12,016
	Organization	12,586
	Publication (Proceedings)	449
	Topics (thesaurus-based)	31,719
	Location	28,741
	Others (Project, Department, etc.)	8,578
Instance relationship		1,553,575
Total		1,659,054

Conclusion

- **Sharing of ontology construction experience**
  - OFK ontology for research area
- **Need for ontology instance management**
  - Proposal of URI-server as a separate instance store
    - Instance storing
    - Instance identity management
    - Integrity check
      - Data integrity
      - Referential integrity
      - Duplicate detection

Thank you !

dbaisk@kisti.re.kr

swlee@kisti.re.kr

Two Sides of Semantic Web

	Open domain	Closed domain
Assumption	Open-world assumption	Closed-world assumption
Type of data	General Web contents	Legacy or security data
Control of Instance integrity	Don't care	Highly needed