Semantic Modeling of Scientist: The VIVO Ontology

VIVO: Enabling National Networking of Scientists is supported by NIH Award U24 RR029822.
Outline

• Why do we need ontology?
• What is the VIVO Ontology?
• How does the VIVO ontology speak to others?
• What is the beauty of semantically annotated data?
Why do we need ontology?
To make our world better connected
Semantic Glue

- Ontology can semantically glue data silos in a meaningful way
  - Ontology has better defined semantics than database schema
  - Ontology is easier to extend and can be based on upper level ontologies (e.g., Basic Formal Ontology)
  - Ontology can provide reasoning power
Linked Open World

Web of Documents → Web of Data → Web of Semantics
Developing a good ontology is HARD

Both for machine and human:

- **Machine-generated Ontology**
  - Shallow hierarchies
  - Lots of classes, less properties
  - Poor quality

- **Human-generated Ontology**
  - Labor-intensive
  - Not timely
  - Good quality
  - Not scalable
VIVO Ontological Challenges

- **Structure-based Ontology**
  - Modeling structure of things
    - FOAF, SIOC
  - Less classes, more properties
  - Very simple, concise

- **Domain-based Ontology**
  - Must be well-established domain
    - Gene Ontology
  - More classes, less properties
  - Complex and long

- **VIVO Ontological Challenges:**
  - Model the social networks of scientists (structure-based)
  - Model the expertise of scientists (domain-based)
What is the VIVO Ontology?
Modeling network of scientists


- Individual
  - Teaching (vivo:TeacherRole, vivo:AdvisingRelationship)
  - Services (vivo:Service, vivo:CoreLaboratory, vivo:MemberRole)
  - Expertise (vivo:SubjectArea)
Modeling expertise of scientists

- Still on the way, potential solutions:
  - Link to domain ontology or taxonomy?
    - which one (UMLS, MeSH, SNOMED)
    - Too many (science, social science, life science)
  - Teaming up with Eagle-I
    - Top-down
    - Bottom-up
    - Middle-out
Interoperability: Building on others

- Dublin core
- Event ontology
- FOAF
- Geopolitical
- SKOS
- BIBO
VIVO ontology localization

• Different localization required by different institutions
  ▫ UF, Cornell, IU, WASHU, Scripps

• How to make localization:
  ▫ Adding local namespace:
    • indiana: http://vivo.indiana.edu/ontology/vivo-indiana/
    • core: http://vivoweb.org/ontology/core#
  ▫ Local classes are the subclasses of the VIVO Core
    • foaf:Person → core:Non-academic → indiana:ProfessionalStaff → indiana:AdministrativeServices
Modeling examples: Teach

- Scenario: Prof. Katy Börner taught S634 information visualization in 2010 Spring

<http://vivo.iu.edu/individual/BornerKaty>
rdf:type
<http://xmlns.com/foaf/0.1/person>.

<http://vivo.iu.edu/individual/BornerKaty>
<http://vivoweb.org/ontology/core#recentCourseTaught>
<http://vivo.iu.edu/individual/course1104667>.

<http://vivo.iu.edu/individual/course1104667>
rdf:type
<http://vivoweb.org/ontology/core#Course>.
RDF Graph

http://xmlns.com/foaf/0.1/person

http://vivo.iu.edu/individual/BornerKaty

http://vivoweb.org/ontology/core#recentCourseTaught

http://vivoweb.org/ontology/core#Course

http://vivo.iu.edu/individual/course11046 67
Modeling examples: Service

- **Scenario:** Ying Ding is a member of VIVO ontology Team

  <http://vivo.iu.edu/individual/DingYing>
  rdf:type
  <http://xmlns.com/foaf/0.1/person> .

  <http://vivo.iu.edu/individual/DingYing>
  <http://www.vivoweb.org/ontology/vo.9/vivo-on-vivo/memberOf>
  <http://data.vivoweb.org/individual/VIVOOntologyTeam> .

  <http://data.vivoweb.org/individual/VIVOOntologyTeam>
  rdf:type
  <http://vivoweb.org/ontology/core#Team> .
RDF Graph

http://xmlns.com/foaf/0.1/person

rdf:type

http://vivo.iu.edu/individual/DingYing

http://www.vivoweb.org/ontology/v0.9/vivo-on-vivo/memberOf

http://vivoweb.org/ontology/core#Team

rdf:type

http://data.vivoweb.org/individual/VIVOONtoologyTeam
Scenario: Prof. Katy Börner organized the workshop of science mapping in March, 2010

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RDF Graph

http://xmlns.com/foaf/0.1/person

http://vivo.iu.edu/individual/BornerKaty

http://vivoweb.org/ontology/core#organizerOf

http://purl.org/ontology/bibo/workshop

http://purl.org/NET/c4dm/event.owl#Event

http://vivo.iu.edu/individual/NSFJSMFWorkshoponMappingofScienceandSemanticWeb
Modeling examples: Research

- Scenario: Prof. Katy Börner is the Co-PI of the VIVO grant

  <http://vivo.iu.edu/individual/BornerKaty>
rdf:type
<http://xmlns.com/foaf/0.1/person> .

  <http://vivo.iu.edu/individual/BornerKaty>
<http://vivoweb.org/ontology/core#coPrincipalInvestigatorOn>
<http://vivo.iu.edu/individual/grant96325> .

  <http://vivo.iu.edu/individual/grant96325>
rdf:type
<http://vivoweb.org/ontology/core#Grant> .
Modeling examples: Research

Modeling examples: Research


How does the VIVO Ontology speak to others?
Bioportal
Neuroscience Information Framework
Ontology for Biomedical Investigation
Biomedical Resource Ontology
Information Artifact Ontology
Neuroscience Information Framework
Ontology for Biomedical Investigation

Linked Open Data

DOAP  SUMO  DublineCor  UMBE  SWRC  Relationship  DOLCE
FOAF  SIOC  Bibo  AKT  Biositemaps  SUMO  SWAN Popular Ontologies

Eagle-I Ontology
Information Networking Ontology Group
VIVO Ontology

Biomedical Resource Ontology
Domain Ontologies
Alignment with Eagle-I

FOAF

Agent

VIVO

Abstract Information
Equipment
Location
Process
Relationship
Information Resource
Dependent Resource
Subject area

Eagle-I

Environment
Funding resource
Subject
Entity
Biological specimen
Training opportunity
Light Microscope
Organism
Gene
Manufacturer
Staff

VIVO

Equipment
Location
Process
Relationship
Information Resource
Dependent Resource
Subject area

area

geopolitical

EVENT

Event

Role

Organization

Biological specimen
Light Microscope
Gene
Manufacturer
Staff
Role

Eagle-I

- Service provider role
- Blinded investigator role
- Blinded subject role
- Blinded outcome assessor role
- Blinded caregiver role
- Funding role
- Educator role

VIVO

- Attendee role
- Clinical role
- Leader role
- Member role
- Outreach provider role
- Presenter role
- Research role
  - Investigator role
    - Co-principal investigator
    - Principal investigator
- Service provider role
- Teacher role
What is the beauty of semantically annotated/linked data?
The Beauties

- Querying heterogeneous data
  - SPARQL query builder
- Finding semantic associations
  - Path-finding algorithm
- Visualizing YOUR network
  - View yourself in the academic mirror
SPARQL Query Builder

• It helps user to build the SPARQL query without any knowledge of SPARQL Query.

• User can also use it as a tool to explore the ontology structure.

• Examples can be complex
  ▫ Find all the publications of Katy in 2005
  ▫ Find all the coauthors of Katy
  ▫ Find all the people that participate the Event where Katy made presentation

http://vivo-onto.slis.indiana.edu/SPARQL/
Semantic Association Finder: Menczer, Filippo & Ostrom, Elinsor

- **Menczer, Filippo**
  - Associate Professor of Informatics and Computer Science
  - Complex Networks
- **Ostrom, Elinor**
  - School of Economics, IUB
  - One of the winners of the 2009 Nobel Memorial Prize in Economic Sciences
- **Mediated Persons:**
  - Folke, Carl
    - Department of Systems Ecology, Stockholm University
    - Carl has extensive experience in interdisciplinary collaboration and has worked with the social and economic dimension of ecosystem management.
  - Marco, Janssen
    - School of Human Evolution and Social Change, Arizona State University
- **Semantic paths:**
  - Filippo co-authored two papers with Folke C., Folke C. co-authored with Janssen Marco, and Janssen Marco and Elinor Ostrom are co-principal investigators on Grant432894: The Dynamics of Rules in Commons Dilemmas
Scenario-3: Menczer, Filippo & Ostrom, Elinsor

Visualization: http://ella.slis.indiana.edu/~binghe/pathfinder3/bin-debug/pathfinder.html
Visualize YOUR network

28 co-author(s)
138 co-author link(s)
Team Work...
Questions?

Thank you!