A Walk Through PROV-O

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Provenance of this presentation

@junszhao http://bit.ly/prov-at-eswc13
• A lightweight OWL-RL ontology
  – http://www.w3.org/ns/prov-o
  – For provenance information interchange
  – Domain-neutral
  – Meant to be extended
  – There are alternate encodings for XML, etc.
Namespaces

- @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
- @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
- @prefix owl: <http://www.w3.org/2002/07/owl#> .
- @prefix prov: <http://www.w3.org/ns/prov#> .
- @prefix : <http://example.com/> .

- "When in doubt, prefix.cc." (e.g. http://prefix.cc/prov)
PROV-O at a glance

- **Starting point terms**
  - 3 classes + 9 properties
  - Simple, binary relations
- **Expanded terms**
  - 7 classes + 16 properties
  - Adds subclasses and subproperties
- **Qualifying relationships**
  - Elaborate 14 of the binary Starting and Expanded relationships
Part I: Starting-point Terms
Starting Points (The Triangle)
Starting Points Example

```
:geneSequencing
    a prov:Activity;
    prov:startedAtTime "2012-04-25T01:30:00Z"^^xsd:dateTime;
    prov:used :drosophilaSample-84;
    prov:wasAssociatedWith :lab-technician-GH-32;
    prov:endedAtTime "2012-04-25T03:40:00Z"^^xsd:dateTime;
.

:drosophilaSample-84
    a prov:Entity;
    prov:wasAttributedTo :lab-technician-FE-56;
.

:lab-technician-GH-32 a prov:Agent .
:lab-technician-FE-56 a prov:Agent .
```
Part II: Expanded Terms
Expanded Terms

**Classes**
- Entity
  - Plan
  - Collection
  - Bundle
- Agent
  - Person
  - Organization
  - SoftwareAgent
- Location

**Properties**
- Derivation(wasDerviedFrom)
  - prov:wasRevisionOf
  - prov:wasQuotedFrom
  - prov:hadPrimarySource
  - prov:wasInfluencedBy
- Statefulness/General v.s. specific
  - prov:specializationOf, prov:alternateOf
- Location
  - prov:atLocation
- prov:value
- Generation v.s. Invalidation
  - Time: prov:wasInvalidatedAt, prov:wasGeneratedAt
- Activity <-> Entity
  - Generation, invalidation, start and end

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## Expanded Terms

### Classes
- **Entity**
  - Plan
  - Collection
  - Bundle
- **Agent**
  - Person
  - Organization
  - SoftwareAgent
- **Location**

### Properties
- **Derivation** (wasDerviedFrom)
  - prov:wasRevisionOf
  - prov:wasQuotedFrom
  - prov:hadPrimarySource
  - prov:wasInfluencedBy
- **Statefulness/General v.s. specific**
  - prov:specializationOf, prov:alternateOf
- **Location**
  - prov:atLocation
- **prov:value**
- **Generation v.s. Invalidation**
  - Time: prov:wasInvalidatedAt, prov:wasGeneratedAt
- **Activity <-> Entity**
  - Generation, invalidation, start and end

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Expanded Terms (1/3):

prov:value (and prov:wasQuotedFrom)

:copied-string
  a prov:Entity;
; prov:wasQuotedFrom

prov:value provides direct representation of an entity. It is similar to rdf:value.
Expanded Terms (2/3):
prov:specializationOf

:copied-string
  a prov:Entity;
  prov:wasQuotedFrom
  :the-wiki-page-that-I-copied-the-text-from;
.

:the-wiki-page-that-I-copied-the-text-from;
  a prov:Entity, ex:WikipediaPage;
  prov:specializationOf
  prov:generatedAtTime "2012-05-16T14:33"^^xsd:dateTime;
.

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Expanded Terms (2/3):
prov:specializationOf

:running_marathon
  a prov:Activity;
  prov:startedAtTime "2011-11-17T10:00:00"^^xsd:dateTime;
  prov:endedAtTime "2011-11-17T17:00:00"^^xsd:dateTime;
  prov:wasAssociatedWith :bob .

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Expanded Terms (2/3):
prov:alternateOf

Two alternate entities present aspects of the same thing. These aspects may be the same or different, and the alternate entities may or may not overlap in time.

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Expanded Terms (3/3):

prov:Bundle

provenance of provenance with a single Class!

@base <http://www.example.com/example.ttl> .

<> # A provenance file located at http://www.example.com/example.ttl
  a prov:Bundle;
  prov:generatedAtTime "2012-05-24T09:30:00"^^xsd:dateTime;
  prov:wasAttributedTo :bob;
  .

:report1
  a my:Report, prov:Entity;
  my:version "1";
  prov:generatedAtTime "2012-05-24T01:00:00"^^xsd:dateTime;
  prov:wasAttributedTo :bob;
  .

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Part III: Qualifying Terms
Qualifying Terms

• Starting point and Expanded relations are binary:

- But we may want to provide more details about that use, or association...
  – *When* and *where* did the Activity use the Entity?
  – *How* did the Agent perform in the Activity?
Qualifying the *Usage* of an Entity

```
Entity -> prov:used -> prov:qualifiedUsage
        |                     |
        v                     
Usage <- prov:entity -> prov:atTime
        |                     |
        v                     
xsd:dateTime
```

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Qualifying the *Usage* of an Entity

More about the time of the usage
Qualifying the Association between an Agent and an Activity
Qualifying the *Association* between an *Agent* and an *Activity*

More about the time of the agent

More about the activity
Qualifying Association: prov:hadRole and prov:hadPlan

:illustrating
  a prov:Activity;
  prov:wasAssociatedWith :derek,
    :steve;
  prov:qualifiedAssociation [
    a prov:Association;
    prov:agent  :derek;
    prov:hadRole :illustrationist;
  ];
  prov:qualifiedAssociation [
    a prov:Association;
    prov:agent  :steve;
    prov:hadRole :stylist;
    prov:hadPlan :style-guide;
    rdfs:comment "Steve helped Derek conform with the publisher's style guide."@en;
  ];
.
:derek a prov:Person, prov:Agent, prov:Entity .
:steve a prov:Person, prov:Agent, prov:Entity .

:illustrationist a prov:Role .
:stylist a prov:Role .

Qualifying Association: prov:hadRole and prov:hadPlan

:illustrating
  a prov:Activity;
  prov:wasAssociatedWith :derek,
    :steve;
  prov:qualifiedAssociation [
    a prov:Association;
    prov:agent :derek;
    prov:hadRole :illustrator;
  ];
  prov:qualifiedAssociation [
    a prov:Association;
    prov:agent :steve;
    prov:hadRole :stylist;
    prov:hadPlan :style-guide;
    rdfs:comment "Steve helped Derek conform with the publisher's style guide."@en;
  ];

:derek a prov:Person, prov:Agent, prov:Entity .
:steve a prov:Person, prov:Agent, prov:Entity .

:illustrator a prov:Role .
:stylist a prov:Role .

The Qualification Pattern

Influence  Derivation  Quotation  Revision  PrimarySource  Start  End

Usage  Communication  Generation  Invalidation  Association  Attribution  Delegation
PROV-O at a glance

• **Starting point** terms
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• **Expanded** terms
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• **Qualifying** relationships
  – Elaborate 14 of the binary Starting and Expanded relationships
Some Final Words about Naming Patterns in PROV-O
The Main Three Classes (1/3)
Qualification Pattern (2/3)

Elaborate 14 of the binary Starting and Expanded relationships

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Elaborate on Pattern (2/3)

Primary Starting and Expanded relationships
Elaborate of the binary StarAng and Expanded relationships.
Organizing Qualifications (3/3)

- Influence
  - ActivityInfluence
    - Communication
    - Generation
    - Invalidation
  - AgentInfluence
    - Association
    - Attribution
    - Delegation
  - EntityInfluence
    - Derivation
      - PrimarySource
      - Quotation
      - Revision
    - End
    - Start
    - Usage

Entity
  - prov:used
  - prov:entity
  - prov:qualifiedUsage

Activity

Usage
  - prov:atTime
  - xsd:dateTime
Acknowledgement

- Tim Lebo:
  - http://tw.rpi.edu/instances/TimLebo

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  - http://www.w3.org/2011/prov#prov-o-team