A Walk Through PROV-O

<>
a :Slides;
prov:wasAttributedTo
  <http://tw.rpi.edu/instances/TimLebo> .

[#this-talk]
a :Talk, prov:Activity;
prov:used <>;
prov:wasAssociatedWith [#me] .

[#me]
foaf:name "Tim Lebo";
prov:specializationOf <http://tw.rpi.edu/instances/TimLebo>
prov:actedOnBehalfOf
  <http://www.w3.org/2011/prov#prov-o-team>,
  <http://www.w3.org/2011/prov>,
  <http://dbpedia.org/resource/W3c>,
  <http://dbpedia.org/resource/Rensselaer_Polytechnic_Institute>,
  <http://tw.rpi.edu/instances/TetherlessWorldConstellation> .
Overview

Part 1:

Part 2:

@timrdf  http://bit.ly/prov-at-iswc-12
• A lightweight OWL-RL ontology
  – Provenance information \textit{interchange}
  – “Simple”
  – Domain-neutral
  – Meant to be extended
  – Encodes PROV-DM’s “abstract model” in RDF
  – There are alternate encodings for XML, etc.
GET http://www.w3.org/ns/prov

• Latest public draft:
  - curl -H "Accept: text/html" -L http://www.w3.org/ns/prov
  - curl -H "Accept: application/rdf+xml" -L http://www.w3.org/ns/prov
  - curl -H "Accept: text/turtle" -L http://www.w3.org/ns/prov

• Latest editor’s draft:
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
  – The basis for the rest of the ontology
  – 3 classes + 9 properties
  – Simple, binary relations

• **Expanded** terms
  – 7 classes + 18 properties
  – Adds subclasses and subproperties

• **Qualifying** relationships
  – Elaborate 14 of the binary Starting and Expanded relationships
Starting Points (Class View)

The 3 main classes (Entity, Activity, Agent) can be organized by time or responsibility.
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- actedOnBehalfOf
- wasAttributedTo
- wasAssociatedWith
- used, wasDerivedFrom
- wasInformedBy, wasGeneratedBy
- startedAtTime, endedAtTime
## Starting Points (Grid View)

<table>
<thead>
<tr>
<th>Agent</th>
<th>Entity</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>actedOnBehalfOf</td>
<td>wasAttributedTo</td>
<td>wasGeneratedBy</td>
</tr>
<tr>
<td>wasAssociatedWith</td>
<td>used</td>
<td>wasInformedBy</td>
</tr>
</tbody>
</table>

```
startedAtTime, endedAtTime
```

"into the past"

"responsibility"
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 .
Expanded Terms

Includes **subclasses** and **subproperties** of Starting Point Terms, plus a few **extras**.

- `xsd:dateTime`
  - `generatedAtTime`
  - `invalidatedAtTime`
- `value`
- `hadMember`
- `wasStartedBy / wasEndedBy`
- `wasInfluencedBy / wasQuotedFrom / wasRevisionOf / hadPrimarySource`
- `xsd:dateTime`
- `alternateOf / specializationOf`
- `atLocation`
- `Activity`
- `Location`
- `Collection`
- `Plan`
- `Bundle`

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Extended Terms (1/5): prov:atLocation and prov:Location

Location can be a geographic place (e.g. Paris, Locker-692) or a non-geographic place (e.g., directory, row, column, URL).
Extended Terms (2/5):

prov:value (and prov:wasQuotedFrom)

:copied-string
  a prov:Entity;
  S. Breyer S. Alito S. Sotomayor E. Kagan"""
prov:wasQuotedFrom
  _of_the_United_States_by_court_composition>
.

prov:value provides direct representation of an entity.
It is similar to rdf:value.
Extended Terms (3/5):
prov:specializationOf

:copied-string
  a prov:Entity;
S. Breyer  S. Alito  S. Sotomayor  E. Kagan"""";
  prov:wasQuotedFrom
_of_the_United_States_by_court_composition>;
  :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
_of_the_United_States_by_court_composition>;
  prov:generatedAtTime "2012-05-16T14:33"^^xsd:dateTime;
.

prov:generatedAtTime "2012-05-16T14:33"
prov:value "A. Scalia"
prov:wasQuotedFrom
Extended Terms (3/5):

prov:specializationOf (and prov:wasRevisionOf)

“provenance of dynamic resources”

http://dbpedia.org/resource/Supreme_Court_of_the_United_States


:ip_64.8.148.34

:ClueBot_NG

prov:wasAttributedTo

prov:wasAttributedTo

prov:generatedAtTime "2012-05-16T14:33:00"

prov:generatedAtTime "2012-05-16T14:33:02"

prov:wasRevisionOf

prov:wasQuotedFrom

prov:value "A. Scalia"
Extended Terms (3/5):
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 .
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.
Extended Terms (5/5):

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;
Qualifying Terms

• **Starting point** and **Expanded** relations are binary:

  - Entity prov:used Activity
  - Agent prov:wasAssociatedWith Activity

• 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 *Usage*

Diagram:
- Entity
- Activity
- Usage
- prov:used
- prov:entity
- prov:qualifiedUsage
- prov:atTime
- xsd:dateTime
Qualifying Association

- Agent
- Activity
- Association
  - Role
  - Plan
  - prov:hadRole
  - prov:hadPlan
  - prov:qualifiedAssociation
  - prov:wasAssociatedWith

prov:agent

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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."
  ];
.

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

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

```

11/12/12
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The Qualification Pattern

Entity prov:used Activity

prov:entity prov:qualifiedUsage Usage

xsd:dateTime

prov:wasAssociatedWith Activity

Agent prov:agent Association prov:qualifiedAssociation

prov:hadRole Plan

prov:hadPlan Role

Influence
Derivation
Quotation
Revision
PrimarySource
Start
End
Usage
Communication
Generation
Invalidation
Association
Attribution
Delegation

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Review: PROV-O at a glance

• **Starting point** terms
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• **Qualifying** relationships
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Overview

Part 1:

```
:swissair_Flight_111_crash
  a prov:Activity;
  prov:used <http://dbpedia>
  prov:startedAtTime "1998-09-02T01
  prov:atLocation <http://dbpedia
```

Part 2:
GET http://www.w3.org/ns/prov

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• Latest editor’s draft:
The Main Three Classes (1/4)

- **Agent**
  - Organization
  - Person
  - SoftwareAgent

- **Entity**
  - Bundle
  - Collection
    - EmptyCollection
    - Plan

- **Activity**
Relating the “Main Three” (2/4)

![Diagram showing relationship between Agent, Activity, and Entity]

- wasInfluencedBy
- actedOnBehalfOf
- hadMember
- used
- wasAssociatedWith
- wasAttributedTo
- wasDerivedFrom
- hadPrimarySource
- wasQuotedFrom
- wasRevisionOf
- wasEndedBy
- wasGeneratedBy
- wasInformedBy
- wasInvalidatedBy
- wasStartedBy

11/12/12
Qualification Pattern (3/4)
Organizing Qualifications (4/4)

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

- **InstantaneousEvent**
  - End
  - Generation
  - Invalidation
  - Start
  - Usage

- **Entity**
  - prov:used

- **Activity**
  - prov:entity
  - prov:qualifiedUsage

- **Usage**
  - prov:atTime

- xsd:dateTime

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  <http://dbpedia.org/resource/Rensselaer_Polytechnic_Institute>,
  <http://tw.rpi.edu/instances/TetherlessWorldConstellation> .