



# A Walk Through PROV-O

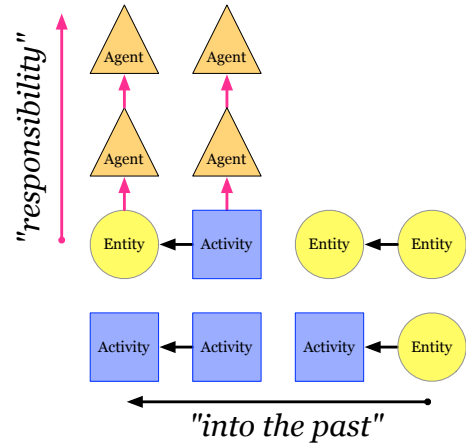
```
<>
  a :Slides;
  prov:wasAttributedTo
    <http://tw.rpi.edu/instances/TimLebo> .

<#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:



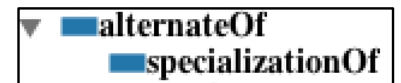
```

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

Part 2:



- ▼ ● Entity
  - Bundle
  - ▼ ● Collection
    - EmptyCollection
    - Plan



# <<http://www.w3.org/ns/prov#>>

- A lightweight OWL-RL ontology
  - Provenance information *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>

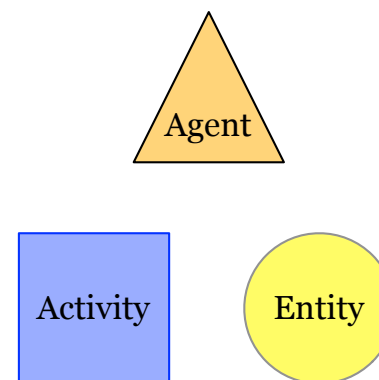
- Latest public draft:
  - curl -H "Accept: **text/html**" -L <http://www.w3.org/ns/prov>
  - curl -H "Accept: **application/rdf+xml**" -L <http://www.w3.org/ns/prov>
  - curl -H "Accept: **text/turtle**" -L <http://www.w3.org/ns/prov>
- Latest editor's draft:
  - <http://bit.ly/prov-o-html>
  - <http://bit.ly/prov-o> (OWL file)

# 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>)

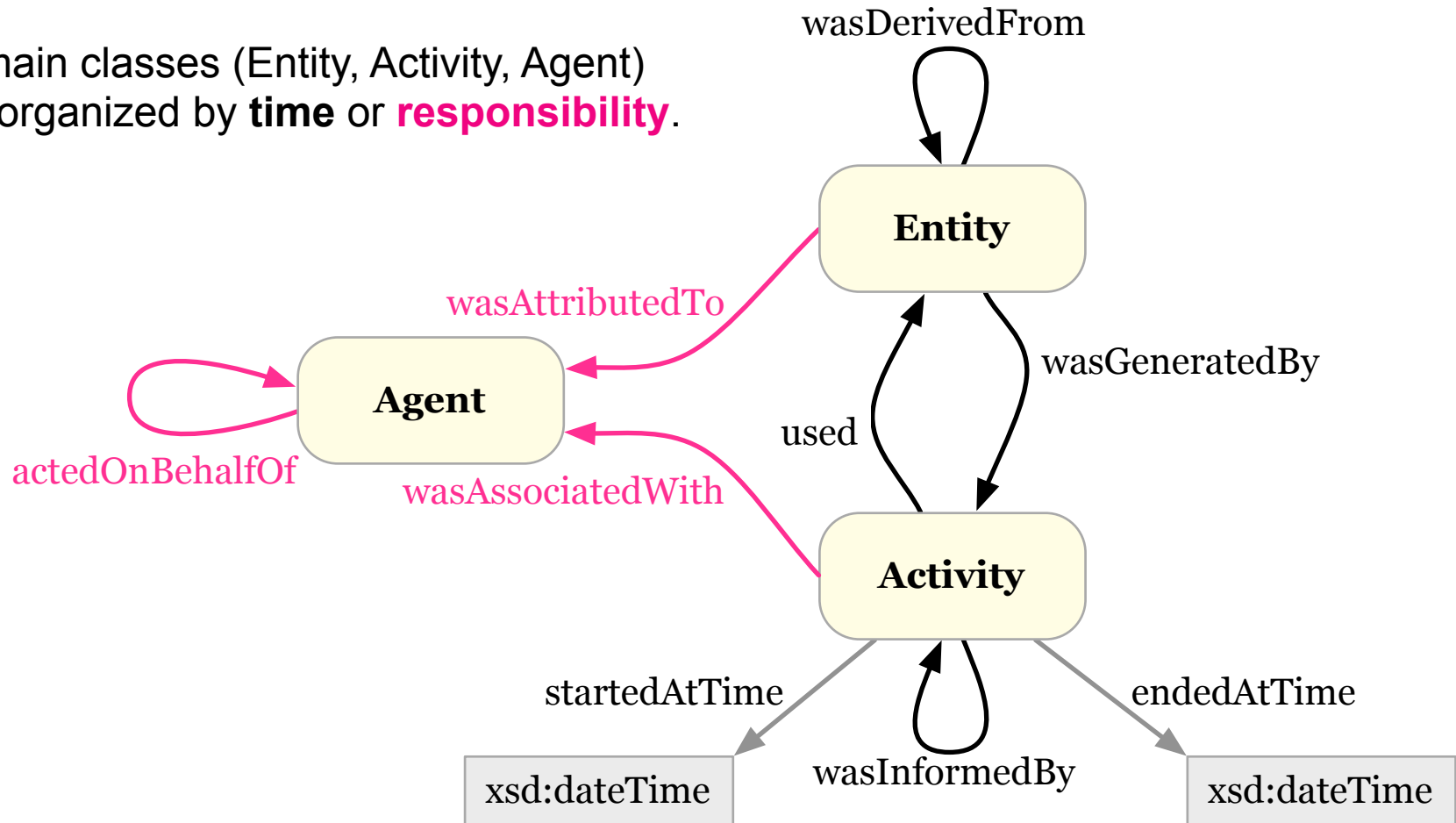
# PROV-O at a glance

- **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

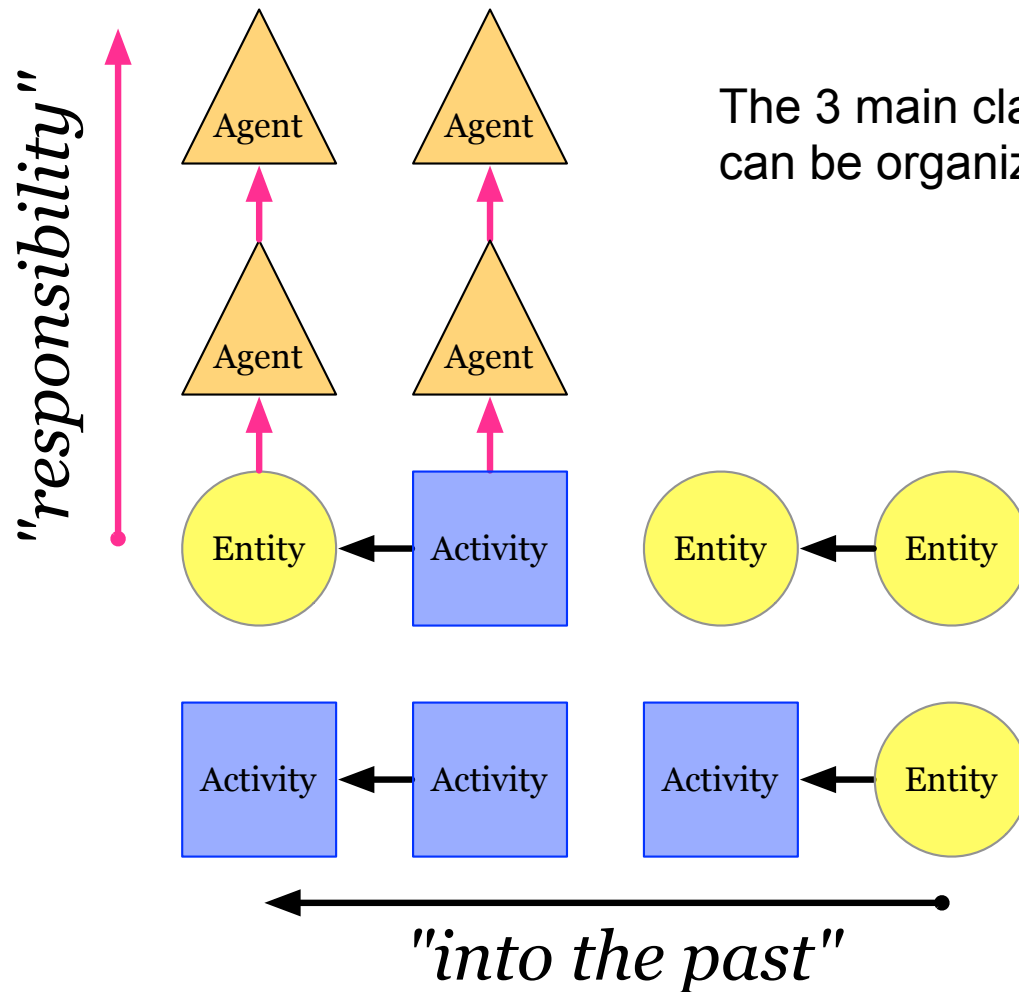


# Starting Points (Class View)

The 3 main classes (Entity, Activity, Agent) can be organized by **time** or **responsibility**.



# Starting Points (2D View)

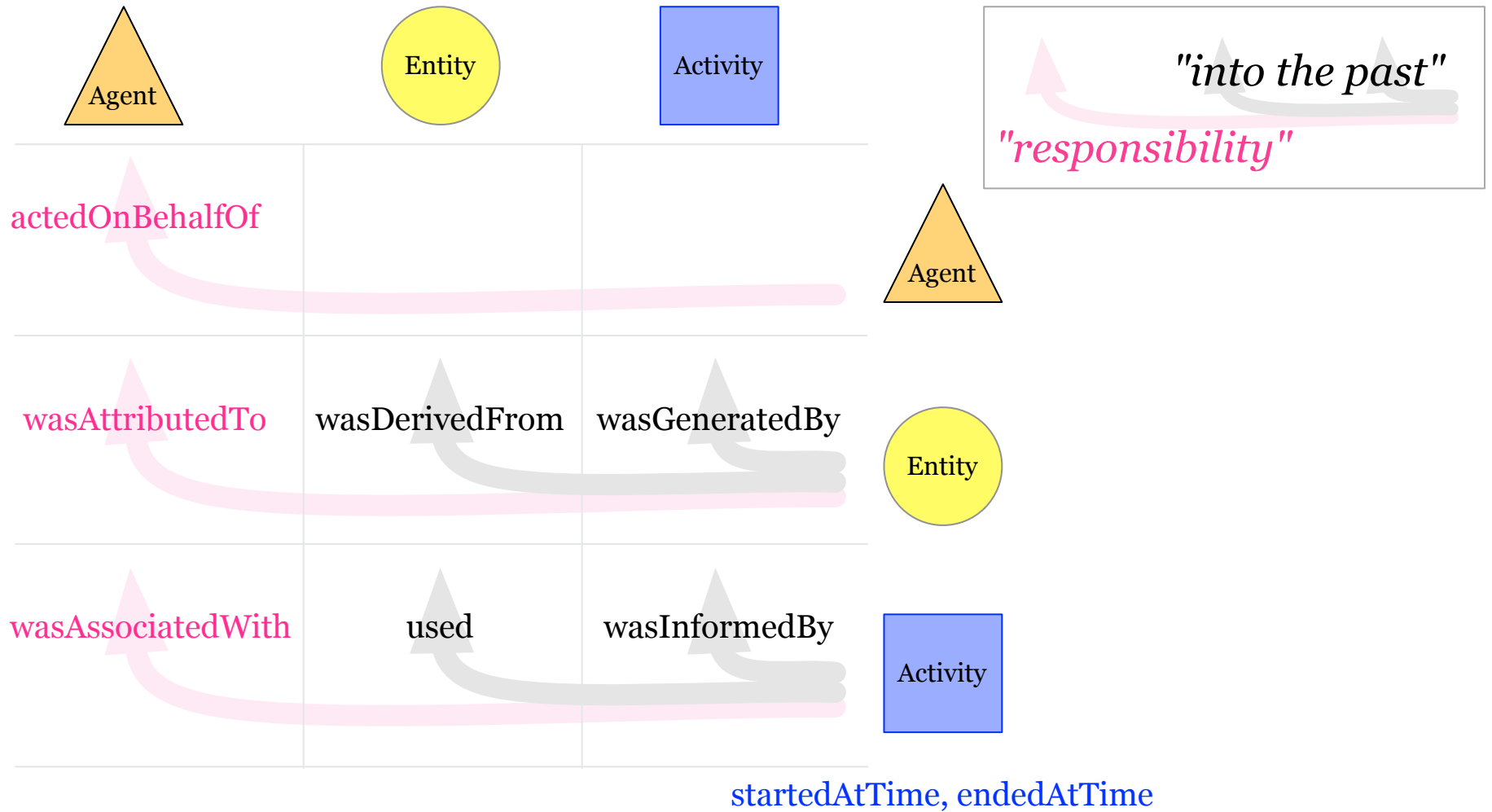


The 3 main classes (Entity, Activity, Agent) can be organized by **time** or **responsibility**.

- actedOnBehalfOf
- wasAttributedTo
- wasAssociatedWith
- used, wasDerivedFrom
- wasInformedBy, wasGeneratedBy
- startedAtTime, endedAtTime



# Starting Points (Grid View)



# Starting Points Example

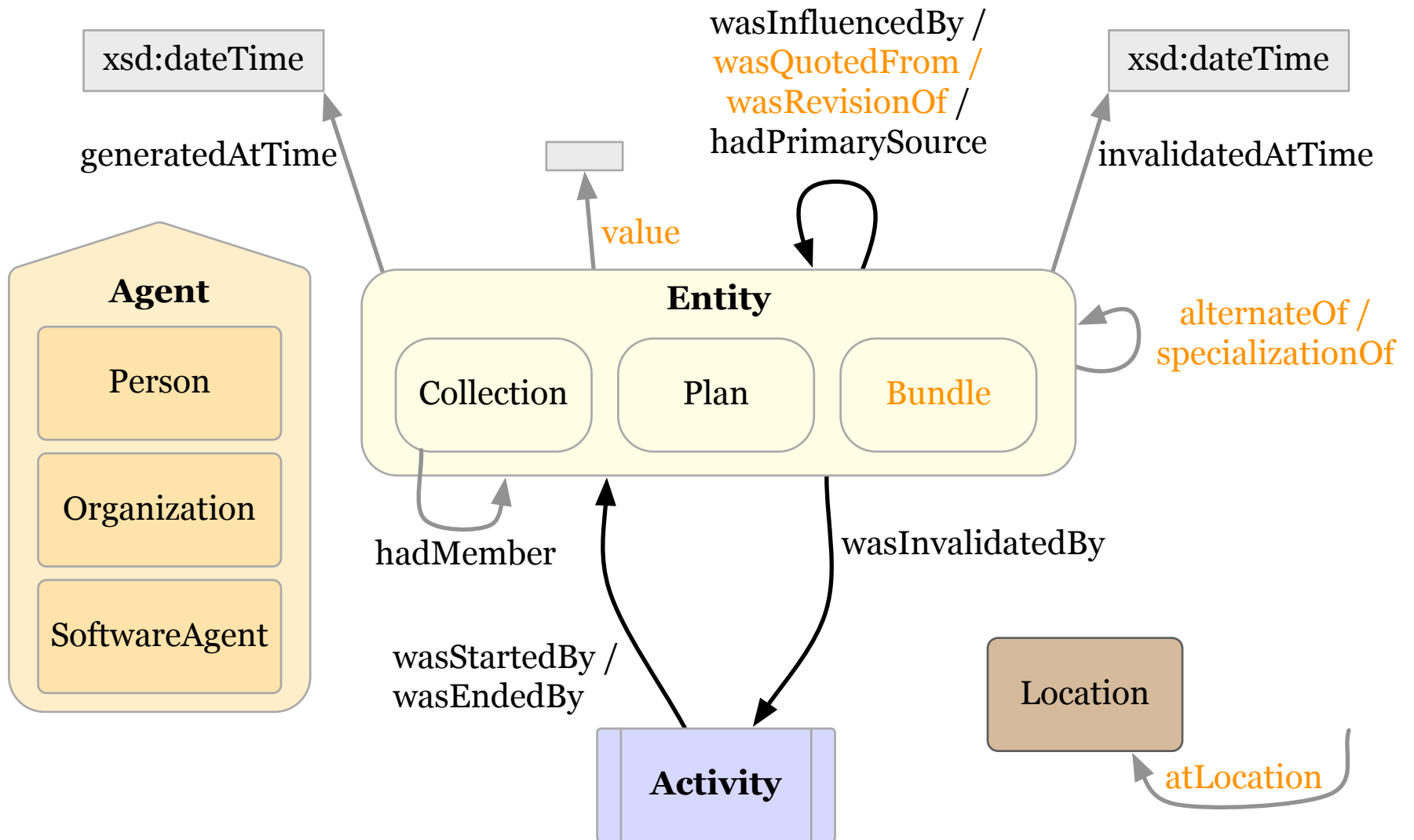
```
:geneSequencing
  a prov:Activity;
  prov:startedAtTime "2012-04-25T01:30:00Z"^^xsd:dateTime;
  prov:used          :drosophilaSample-84;
  prov:wasAssociatedWith :lab-technician-GH-32;
  prov:endedAtTime    "2012-04-25T03:40:00Z"^^xsd:dateTime;
.

: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**.



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

```
:swissair_Flight_111_crash
  a prov:Activity;
  prov:used          <http://dbpedia.org/resource/Swissair_Flight_111>;
  prov:startedAtTime "1998-09-02T01:31:00Z";
  prov:atLocation    <http://dbpedia.org/resource/Atlantic_ocean>;
```

*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)

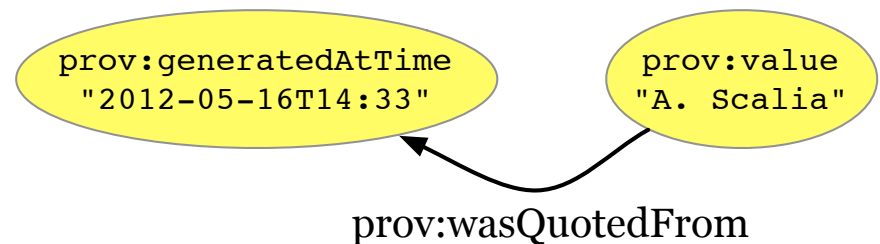
```
:copied-string
  a prov:Entity;
  prov:value ""2010-present: A. Scalia A. Kennedy C. Thomas R.B. Ginsburg
             S. Breyer S. Alito S. Sotomayor E. Kagan"";
  prov:wasQuotedFrom
    <http://en.wikipedia.org/wiki/List_of_Justices_of_the_Supreme_Court
      _of_the_United_States_by_court_composition>
```

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;
  prov:value ""2010-present: A. Scalia A. Kennedy C. Thomas R.B. Ginsburg
            S. Breyer S. Alito S. Sotomayor E. Kagan"";
  prov:wasQuotedFrom
    <http://en.wikipedia.org/wiki/List_of_Justices_of_the_Supreme_Court
      _of_the_United_States_by_court_composition>;
  → :the-wiki-page-that-I-copied-the-text-from;
```

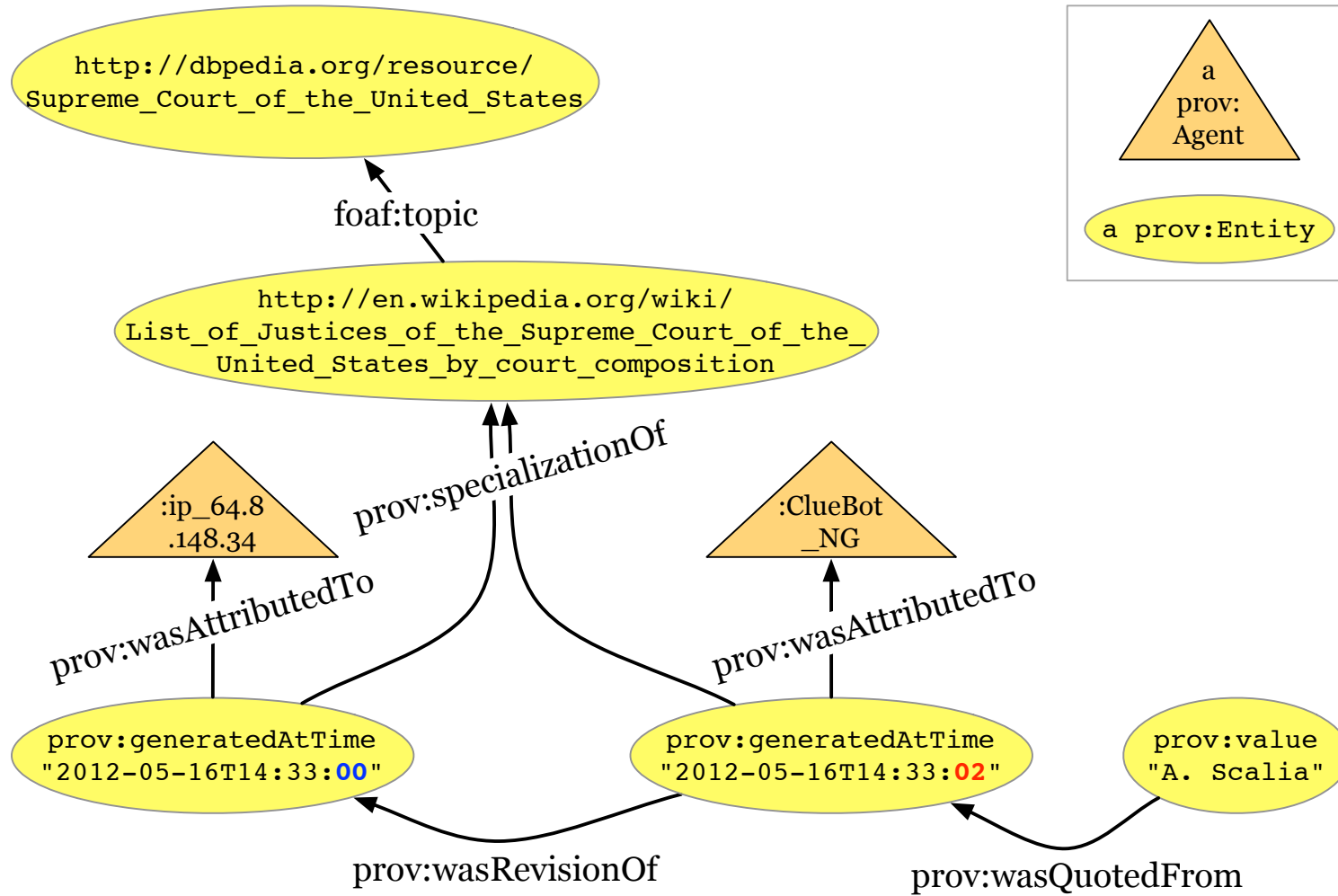
```
·
:the-wiki-page-that-I-copied-the-text-from;
  a prov:Entity, ex:WikipediaPage;
  prov:specializationOf
    <http://en.wikipedia.org/wiki/List_of_Justices_of_the_Supreme_Court
      _of_the_United_States_by_court_composition>;
  prov:generatedAtTime "2012-05-16T14:33"^^xsd:dateTime;
```



# Extended Terms (3/5):

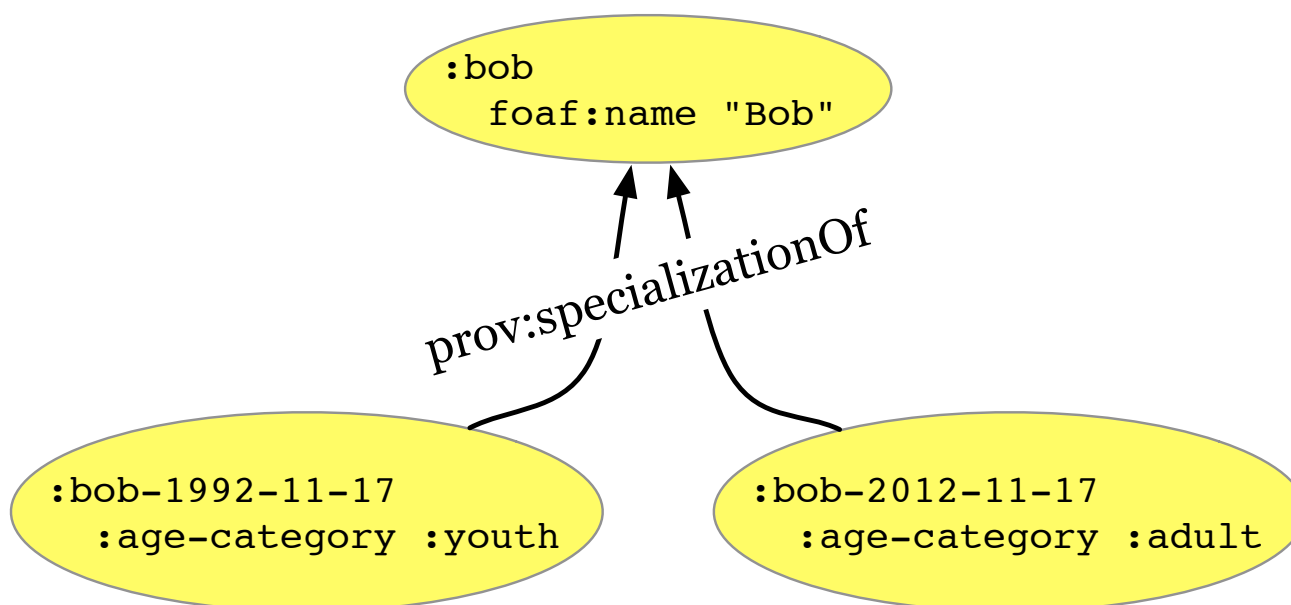
## prov:specializationOf (and prov:wasRevisionOf)

*“provenance of dynamic resources”*



# 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 .
:bob-2011-11-17 prov:specializationOf :bob .
```



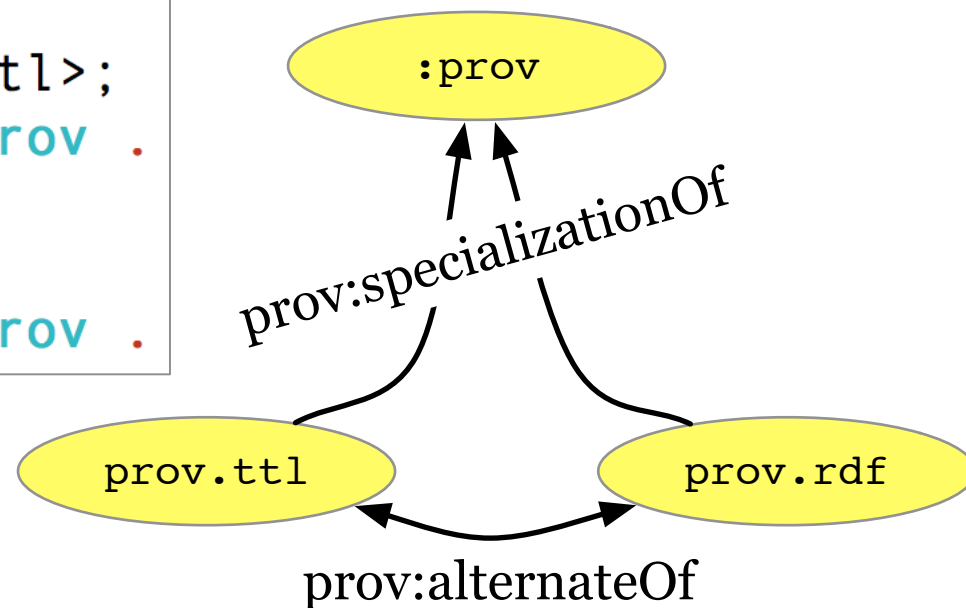


# Extended Terms (4/5):

## prov:alternateOf

```
curl -sH "Accept: text/turtle" -L http://www.w3.org/ns/prov > prov.ttl  
curl -sH "Accept: application/rdf+xml" -L http://www.w3.org/ns/prov > prov.rdf
```

```
<prov.rdf>  
  prov:alternateOf <prov.ttl>;  
  prov:specializationOf :prov .  
  
<prov.ttl>  
  prov:specializationOf :prov .
```



*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!*

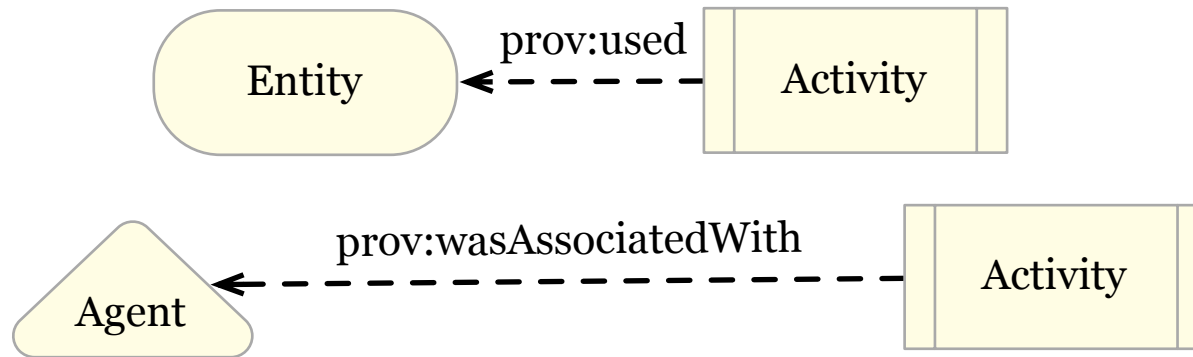
```
@base <http://www.example.com/example.ttl> .

<> # 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;
.
```

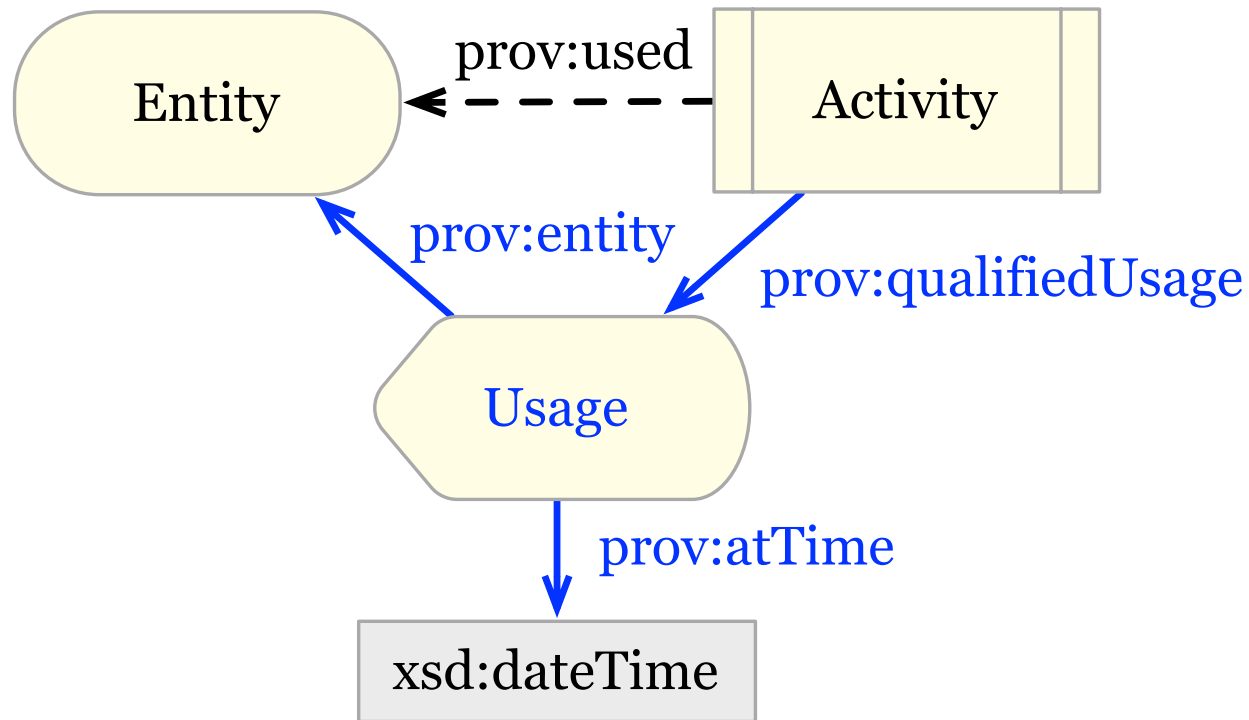
# Qualifying Terms

- Starting point and Expanded relations are binary:

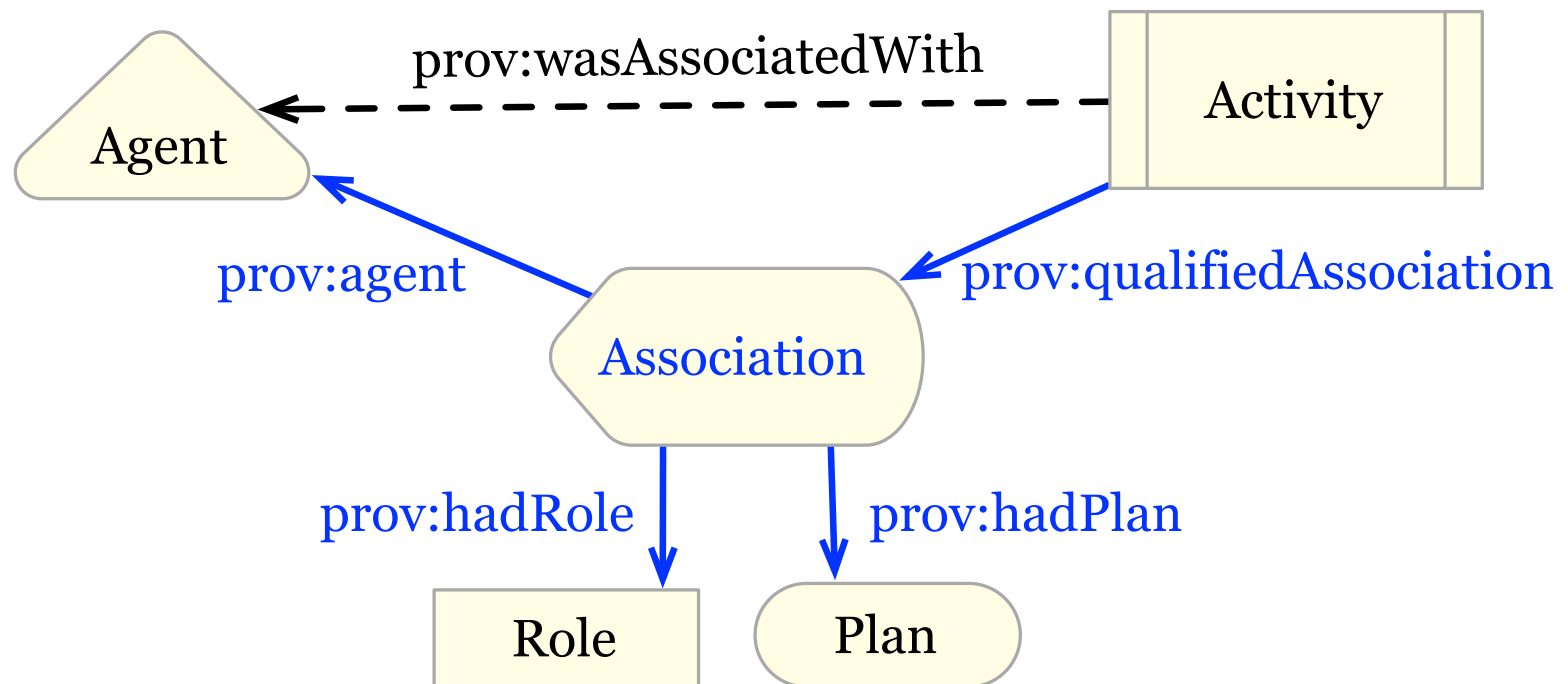


- But we may want to provide more details about that *use*, or *association*...
  - *When* and *where* did the Activity use the Entity?
  - *How* did the Agent perform in the Activity?

# Qualifying *Usage*



# Qualifying Association



# 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."
  ];
.
```

(blank nodes for illustration ONLY!)

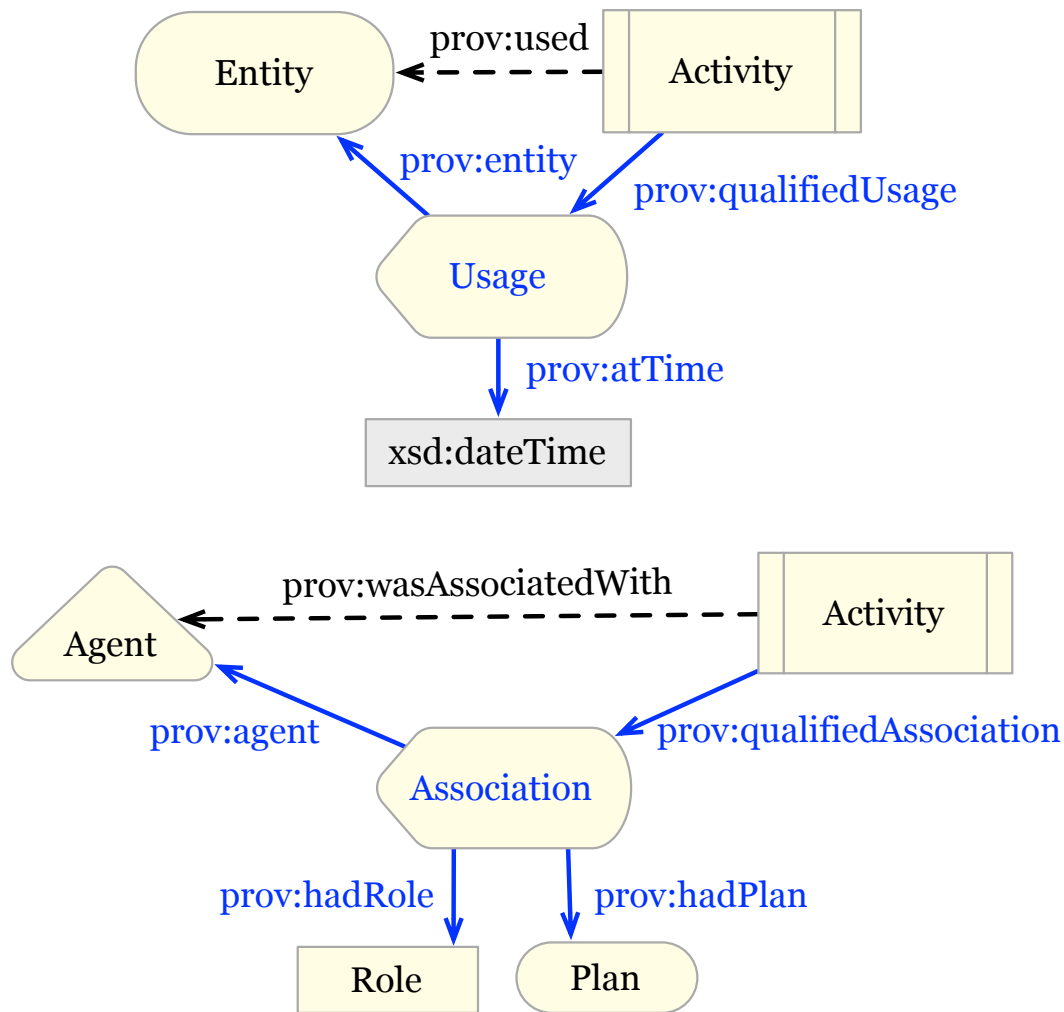
(prov:had\* naming convention\*)

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

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

```
:style-guide a prov:Plan, prov:Entity .
```

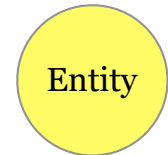
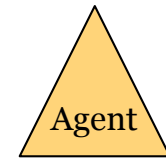
# The Qualification Pattern



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

# Review: PROV-O at a glance

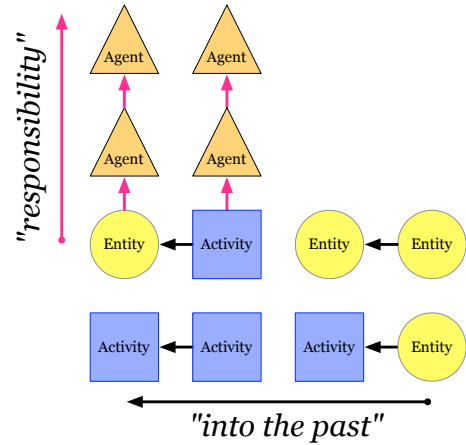
- **Starting point terms**
  - The basis for the rest of the ontology
  - 3 classes + 9 properties
  - Simple, binary relations
- **Expanded terms**
  - 7 classes + 18 properties
  - Adds subclasses and subproperties
- **Qualifying relationships**
  - Elaborate 14 of the binary **Starting** and **Expanded** relationships





# Overview

Part 1:



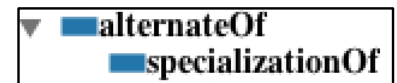
```

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

Part 2:



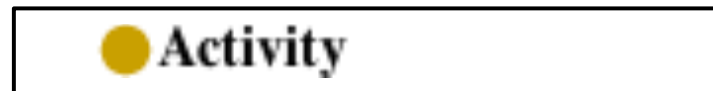
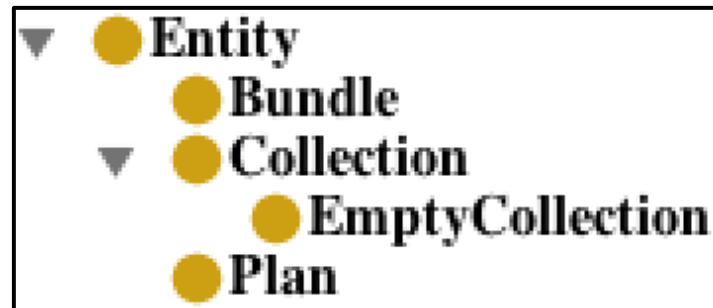
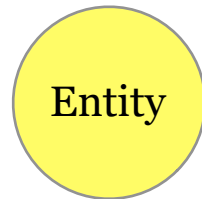
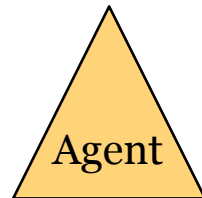
- ▼ ● Entity
  - Bundle
  - ▼ ● Collection
    - EmptyCollection
    - Plan



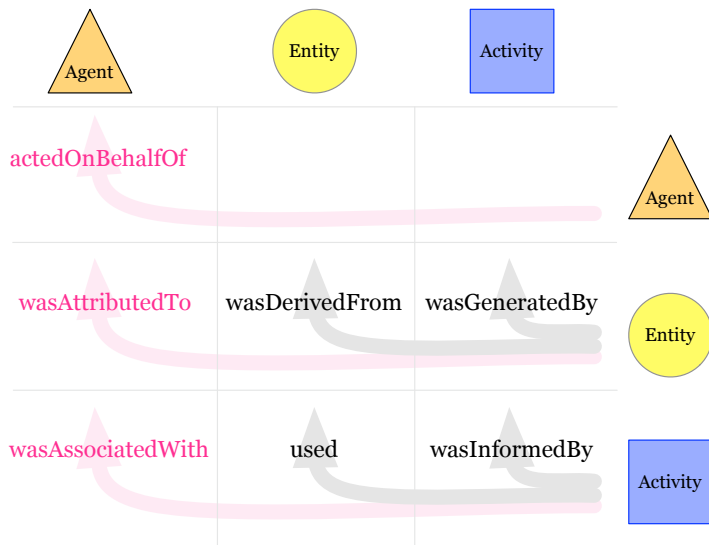
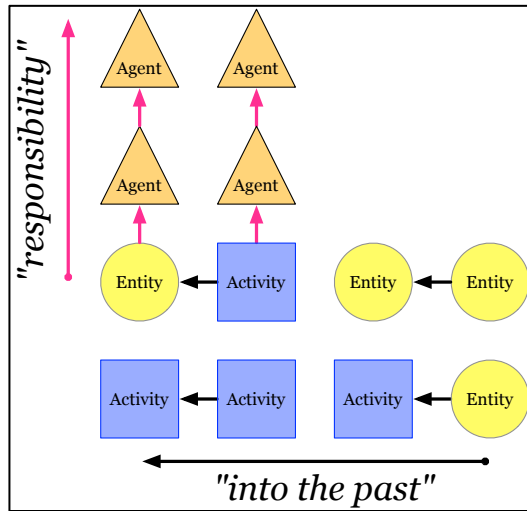
# GET <http://www.w3.org/ns/prov>

- 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:
  - <http://bit.ly/prov-o-html>
  - <http://bit.ly/prov-o> (OWL file)

# The Main Three Classes (1/4)

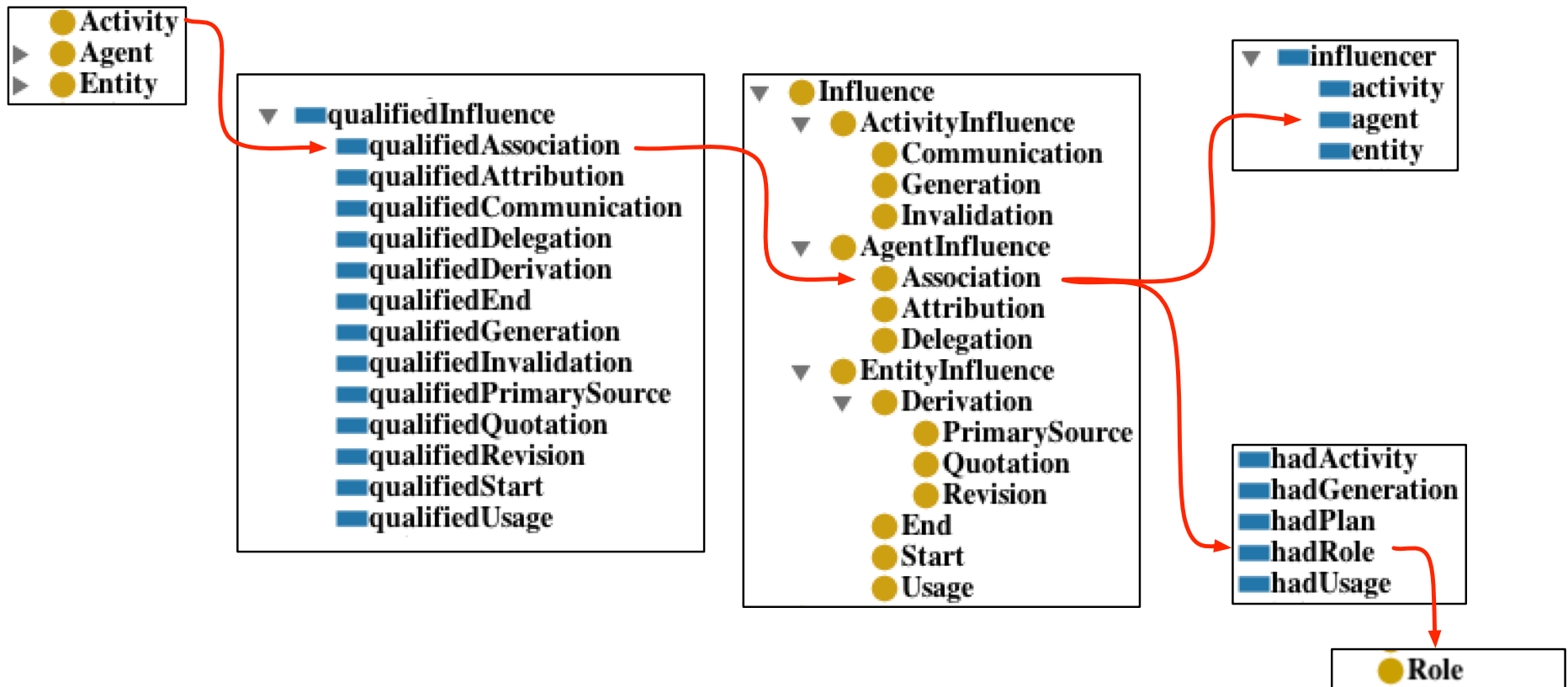


# Relating the “Main Three” (2/4)

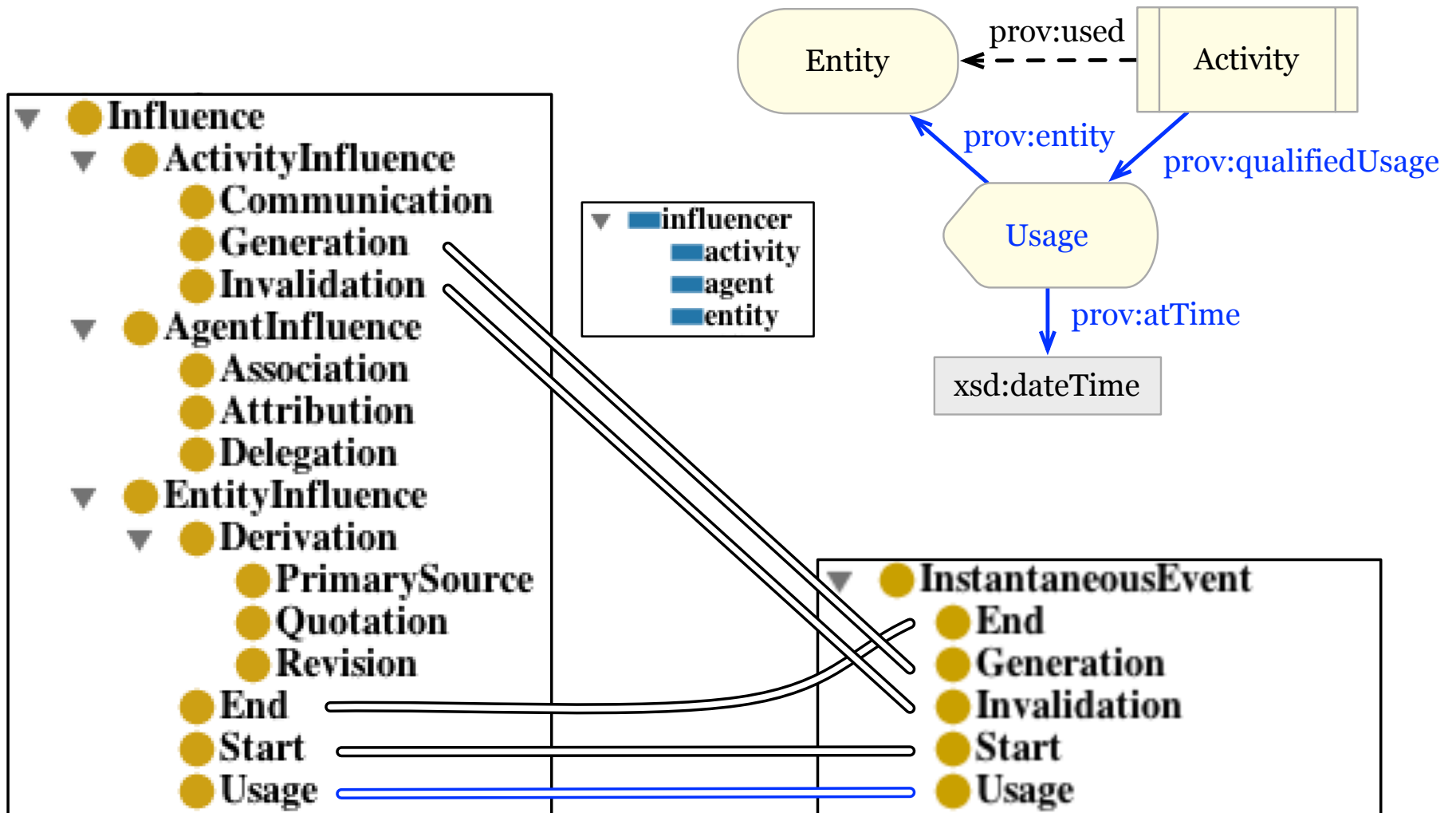


- ▼ **wasInfluencedBy**
- actedOnBehalfOf**
- hadMember**
- used**
- wasAssociatedWith**
- wasAttributedTo**
- ▼ **wasDerivedFrom**
- hadPrimarySource**
- wasQuotedFrom**
- wasRevisionOf**
- wasEndedBy**
- wasGeneratedBy**
- wasInformedBy**
- wasInvalidatedBy**
- wasStartedBy**

# Qualification Pattern (3/4)



# Organizing Qualifications (4/4)





# 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> .
```