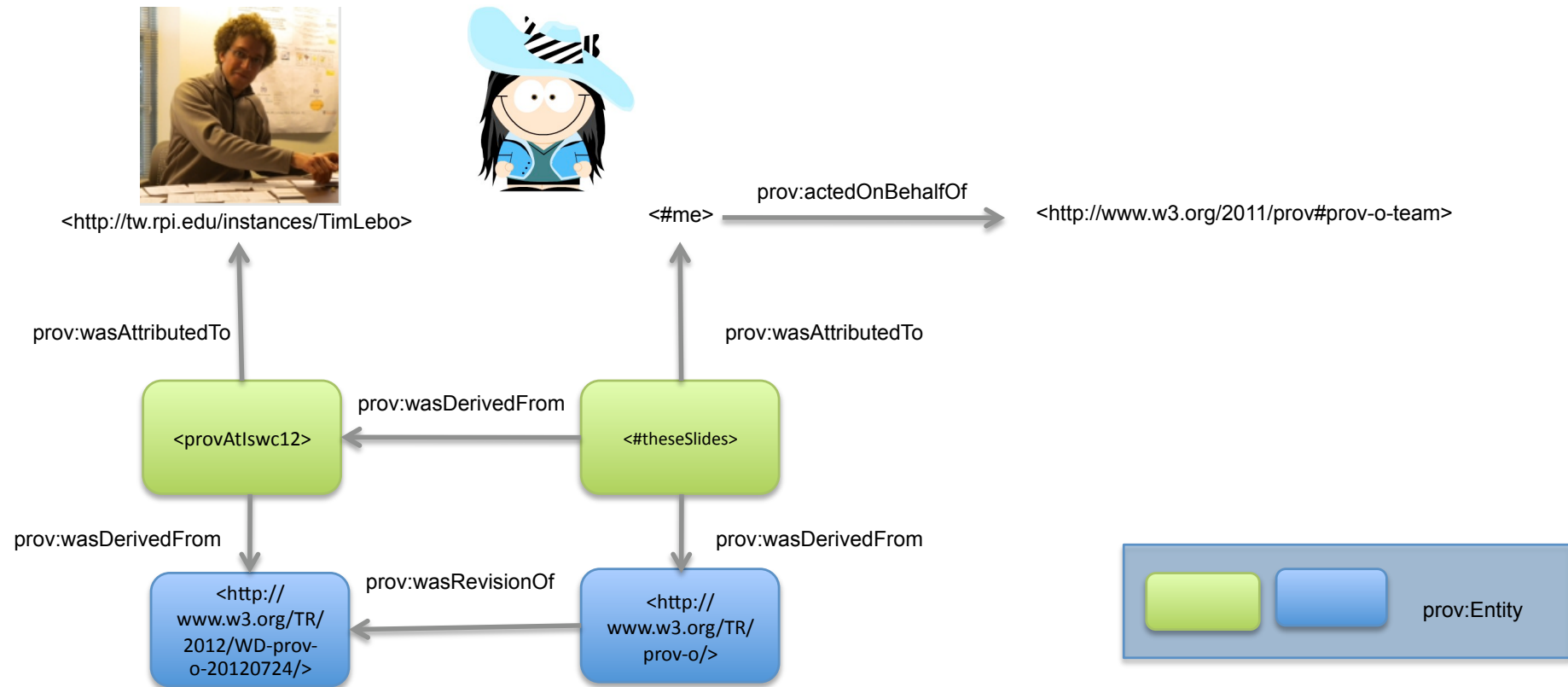


A Walk Through PROV-O

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University of Oxford

Provenance of this presentation



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

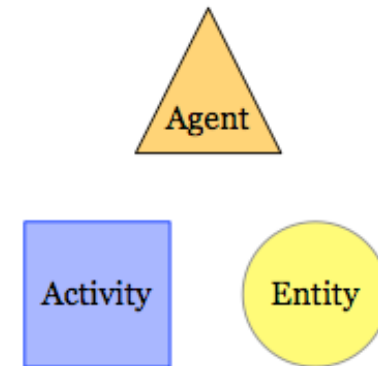
- A lightweight OWL-RL ontology
 - <http://www.w3.org/ns/prov-o>
 - For provenance information *interchange*
 - Domain-neutral
 - Meant to be extended
 - There are alternate encodings for XML, etc.

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>)

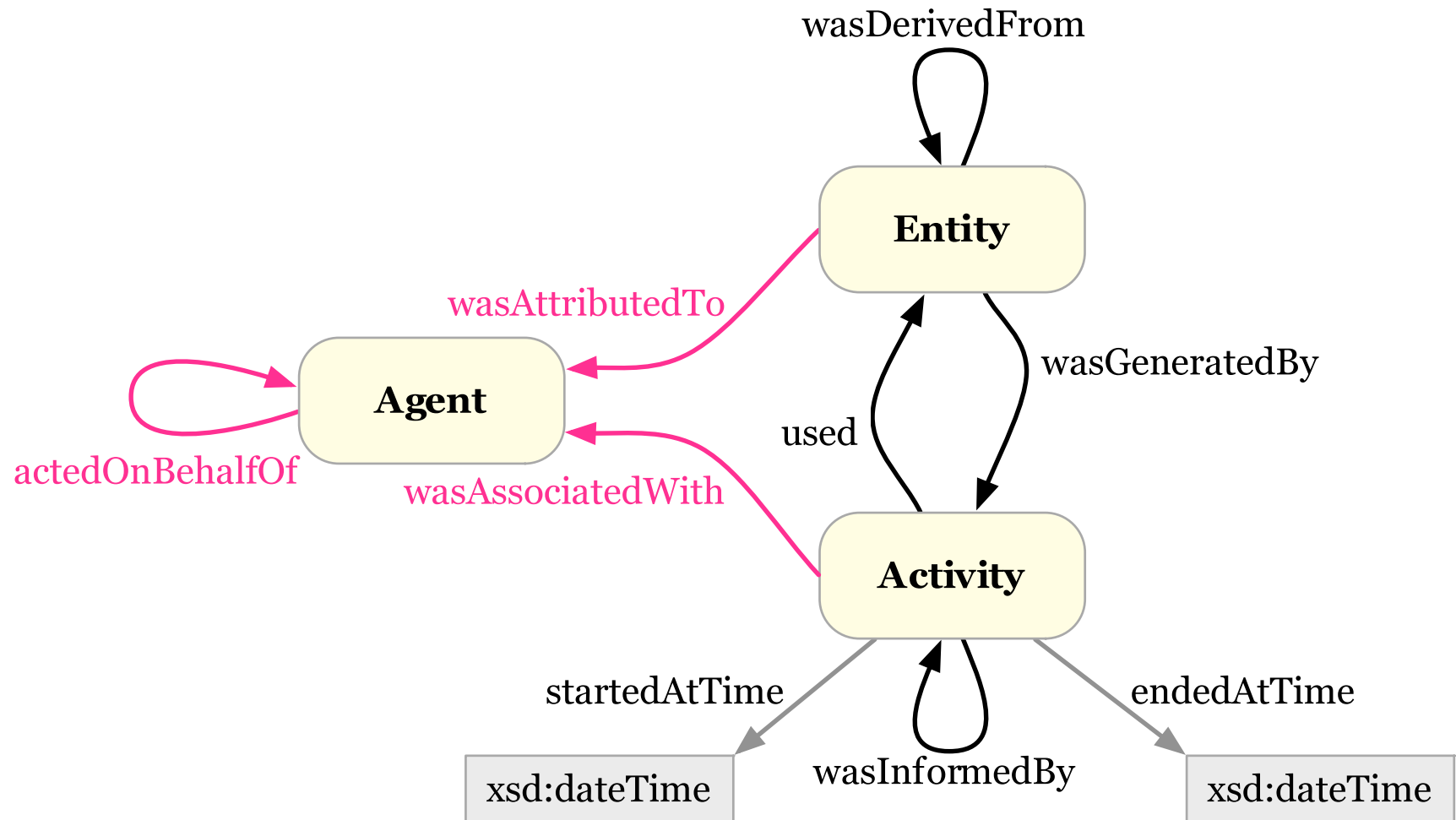
PROV-O at a glance

- 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

▼ wasInfluencedBy

- actedOnBehalfOf
- hadMember
- used
- wasAssociatedWith
- wasAttributedTo
- ▼ ■ wasDerivedFrom
 - derivedByInsertionFrom
 - derivedByRemovalFrom
 - hadPrimarySource
 - wasQuotedFrom
 - wasRevisionOf
- wasEndedBy
- wasGeneratedBy
- wasInformedBy
- wasInvalidatedBy
- wasStartedBy

Properties

- Derivation(wasDerivedFrom)
 - 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

Expanded Terms

Classes

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

Properties

- Derivation(wasDerivedFrom)
 - 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

Expanded Terms (1/3):

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>
.
```

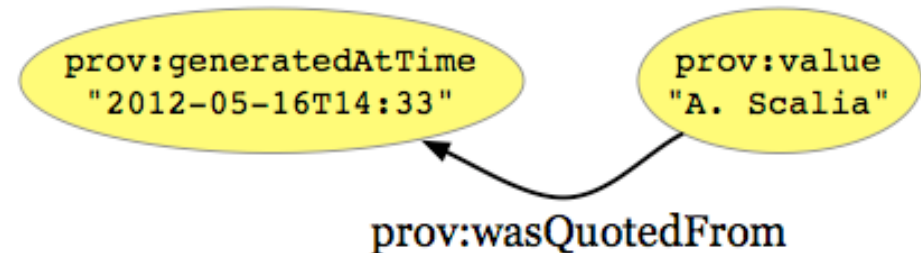
prov:value provides direct representation of an entity.
It is similar to rdf:value.

Expanded Terms (2/3):

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;
```

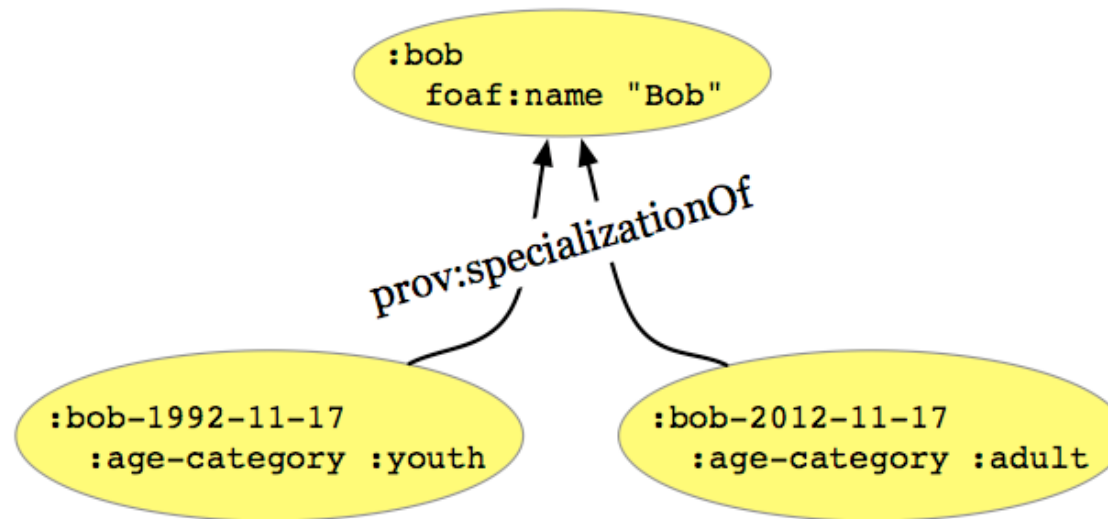
```
.
:the-wiki-page-that-I-copied-the-text-from;
  a prov:Entity, ex:WikipediaPage;
  prov:specializationOf
    <http://en.wikipedia.org/wiki/List_of_Justices_of_the_Supreme_Court
      _of_the_United_States_by_court_composition>;
  prov:generatedAtTime "2012-05-16T14:33"^^xsd:dateTime;
```



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 .
:bob-2012-11-17      prov:specializationOf :bob .
```

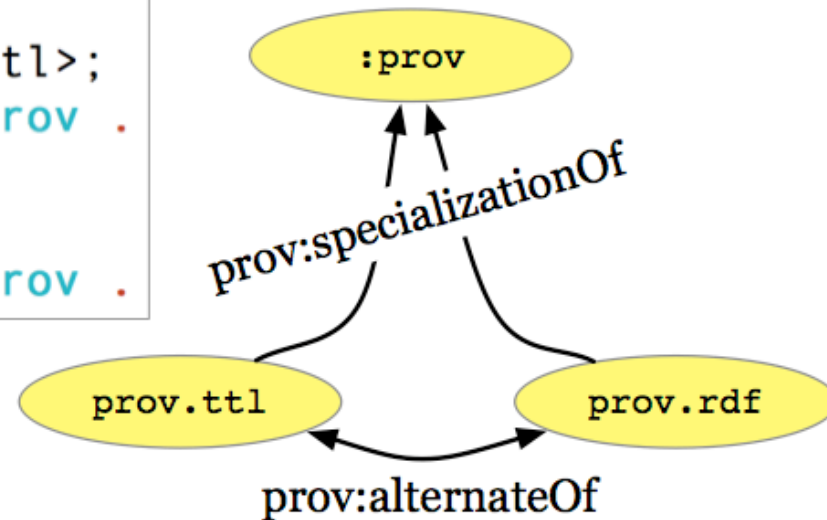


Expanded Terms (2/3):

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.

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;
```

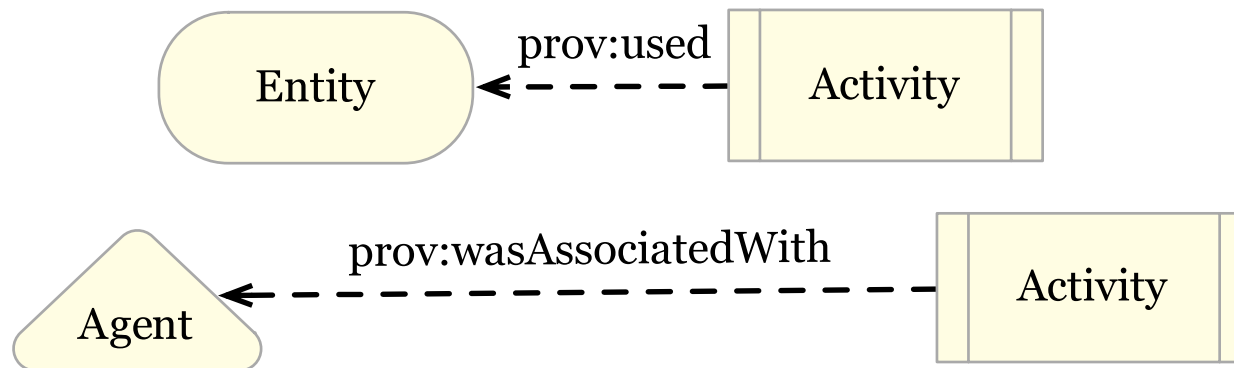
```
  prov:wasAttributedTo :bob;
```

```
.
```


Part III: Qualifying Terms

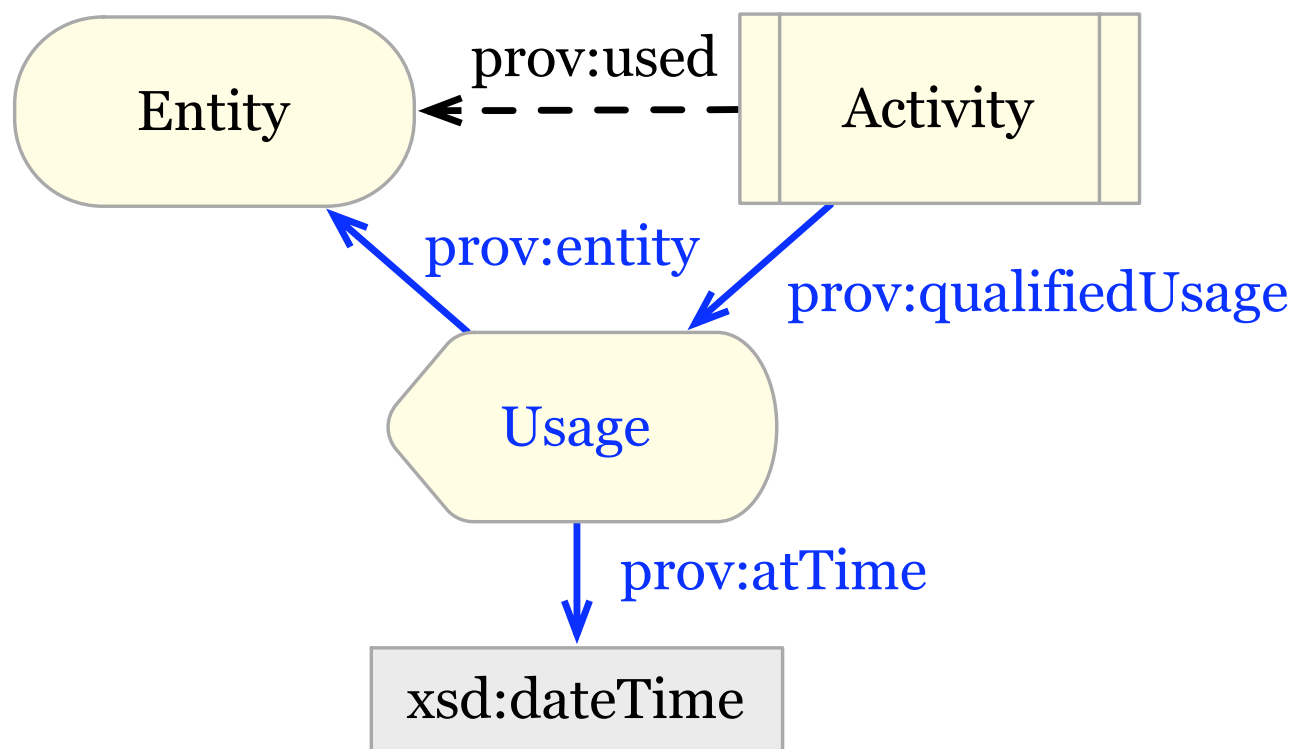
Qualifying Terms

- Starting point and Expanded relations are binary:

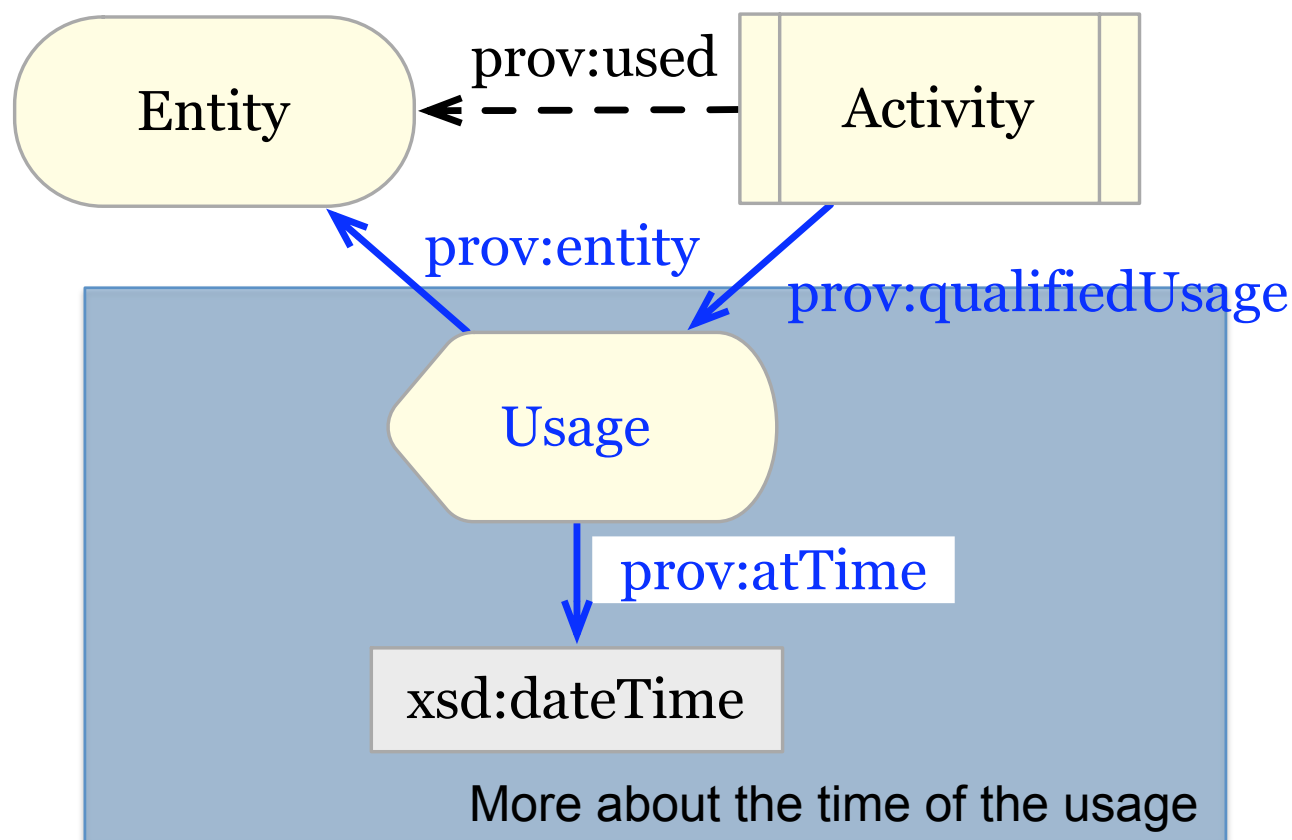


- But we may want to provide more details about that *use*, or *association*...
 - *When* and *where* did the Activity use the Entity?
 - *How* did the Agent perform in the Activity?

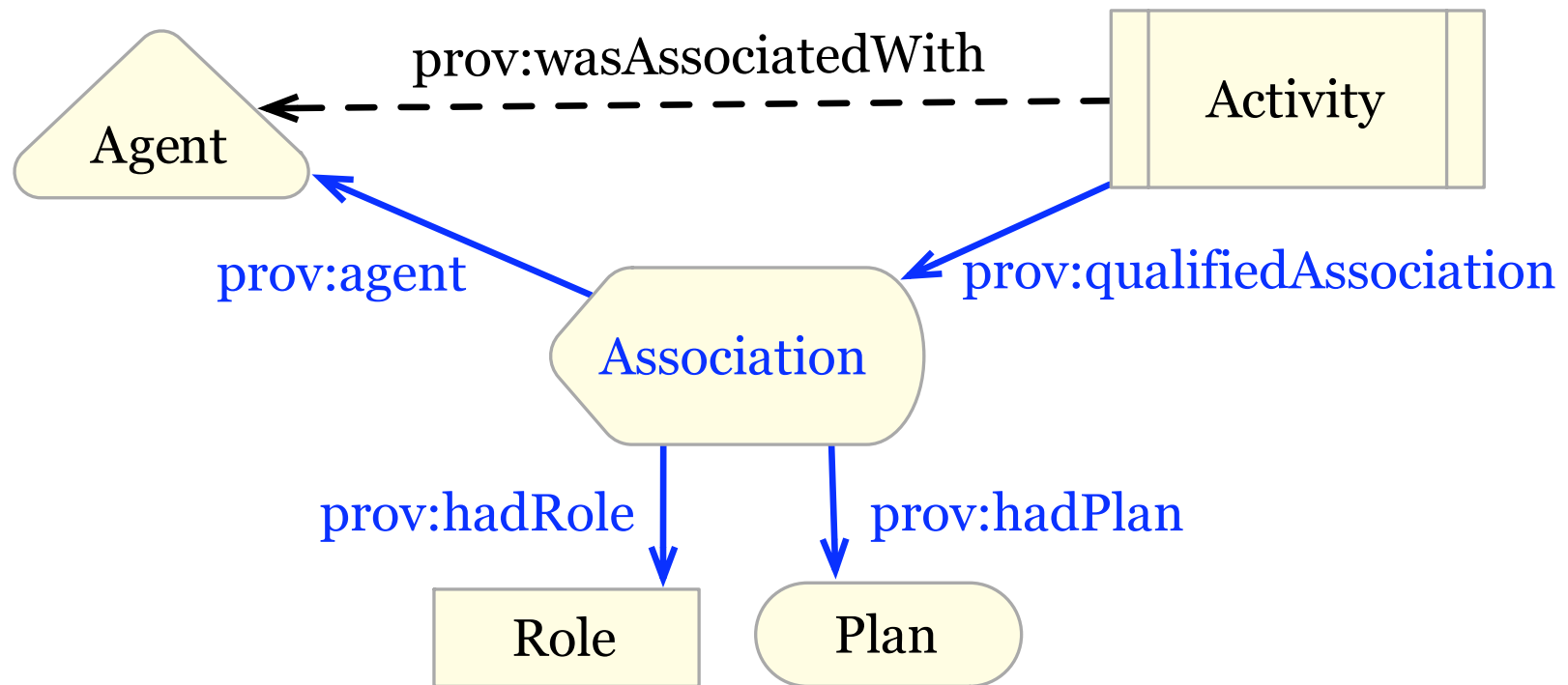
Qualifying the *Usage* of an Entity



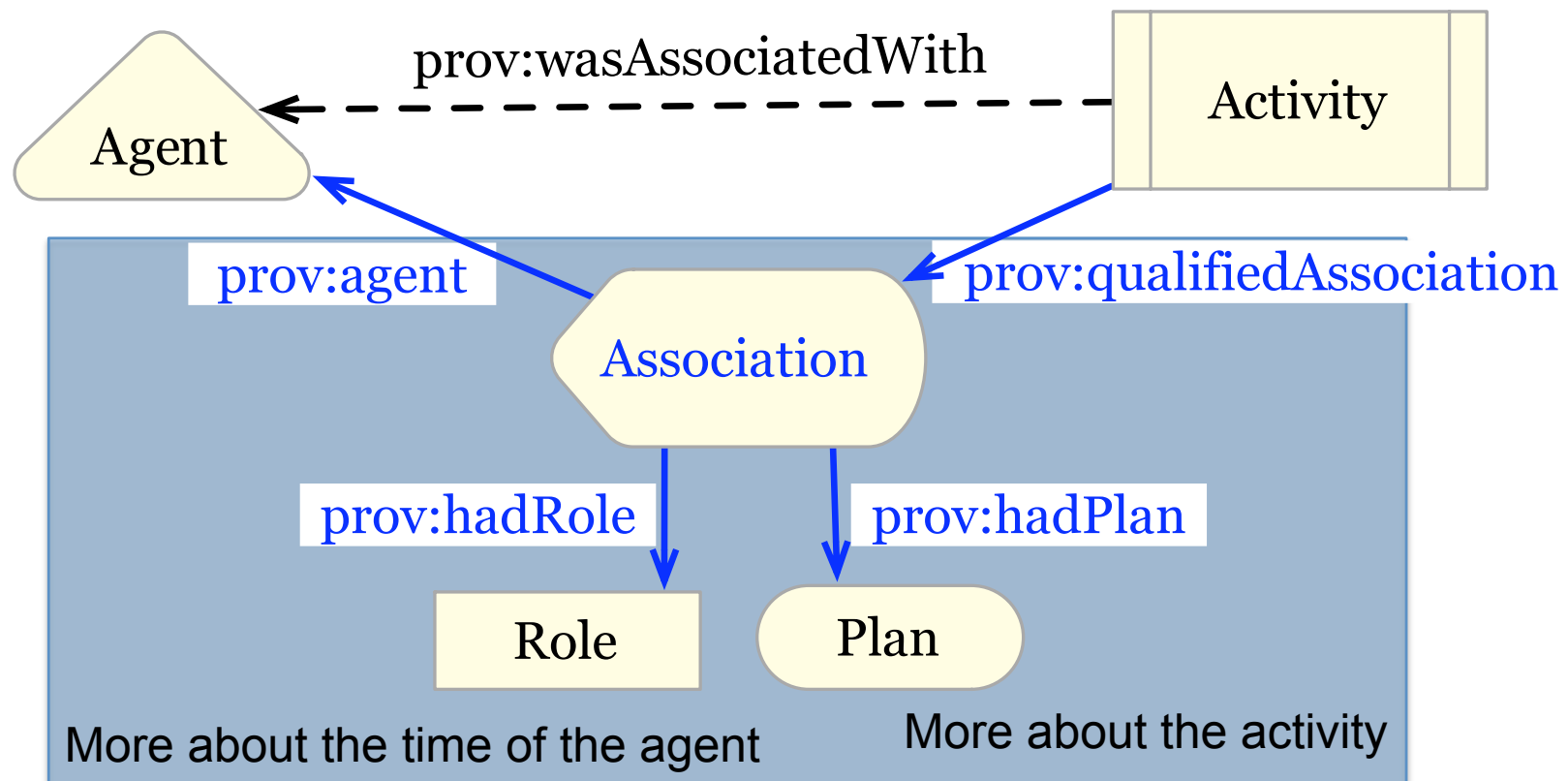
Qualifying the *Usage* of an Entity



Qualifying the *Association* between an *Agent* and an *Activity*



Qualifying the *Association* between an *Agent* and an *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;
```

(blank nodes for illustration ONLY!)

```
];  
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;  
];  
.
```

(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 .
```

Qualifying Association:

prov:hadRole and prov:hadPlan

:illustrating

```
a prov:Activity;  
prov:wasAssociatedWith :derek,  
                        :steve;
```

```
prov:qualifiedAssociation [           (blank nodes for illustration ONLY!)
```

```
  a prov:Association;  
  prov:agent      :derek;  
  prov:hadRole    :illustrationist;
```

```
];
```

```
prov:qualifiedAssociation [
```

```
  a prov:Association;  
  prov:agent      :steve;           (prov:had* naming convention*)  
  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 .
```

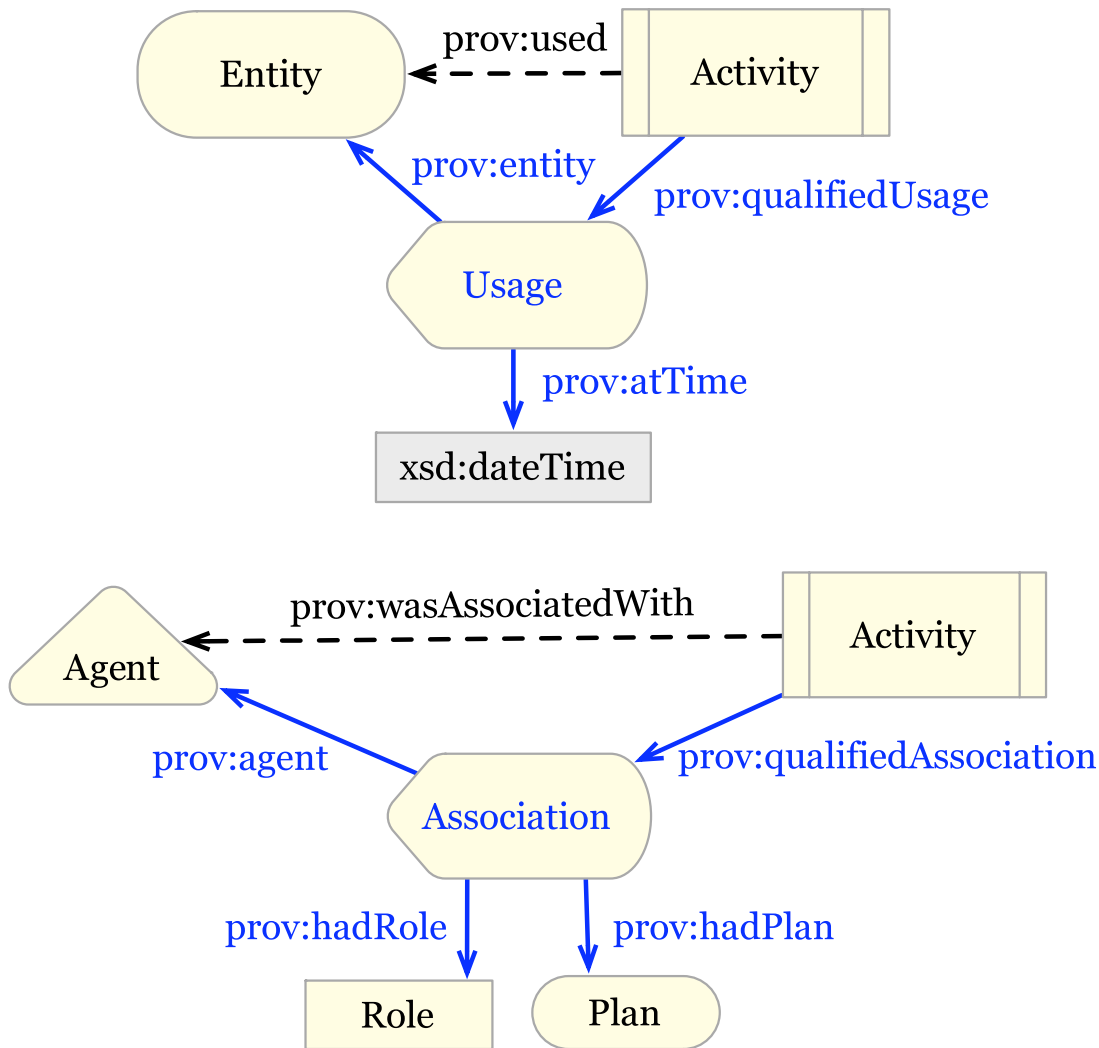
```
:steve a prov:Person, prov:Agent, prov:Entity .
```

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

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

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

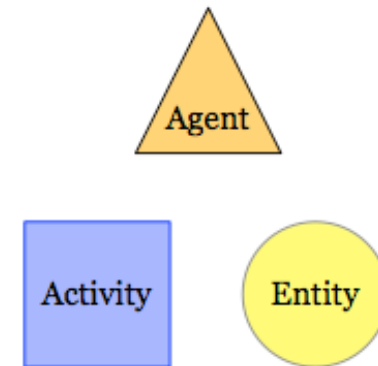

The Qualification Pattern



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

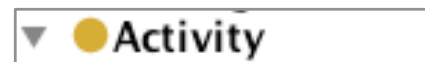
PROV-O at a glance

- Starting point terms
 - 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



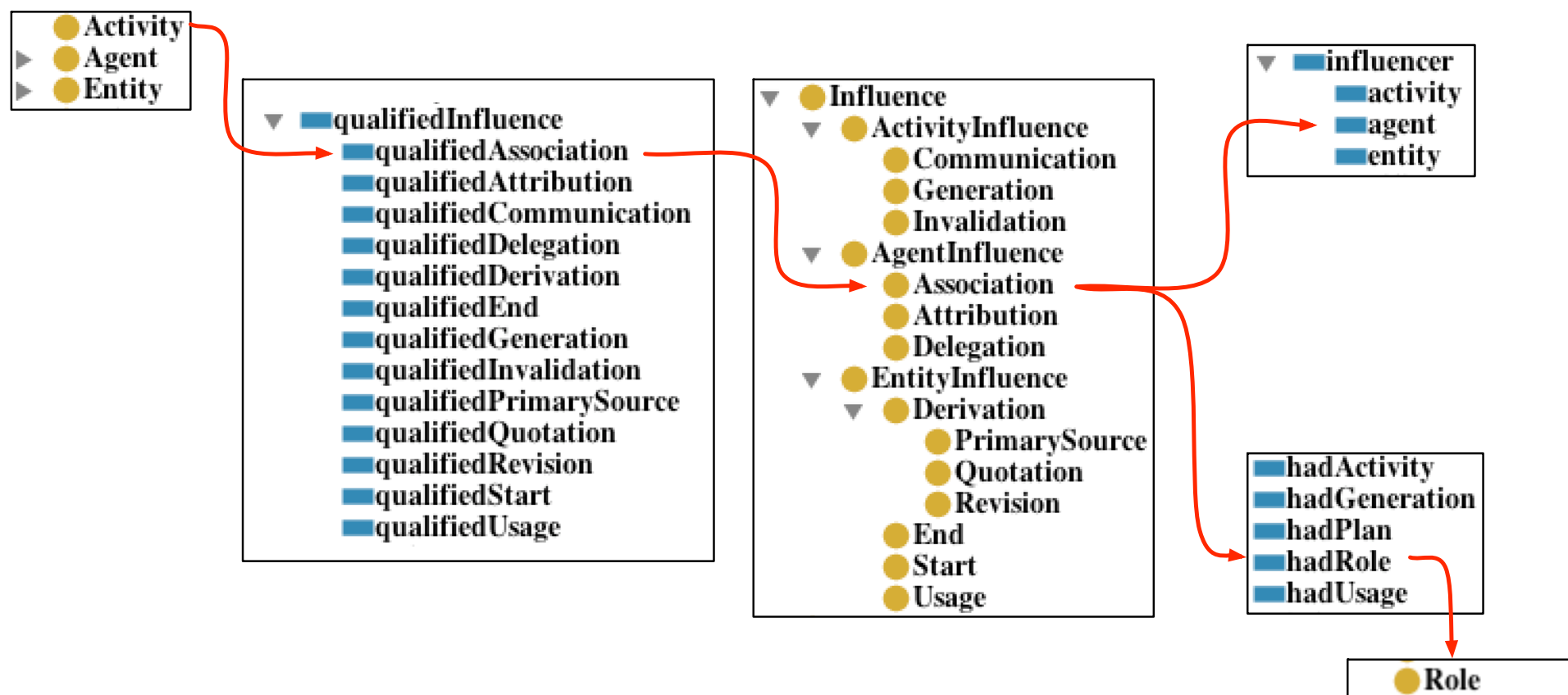
Some Final Words about Naming Patterns in PROV-O

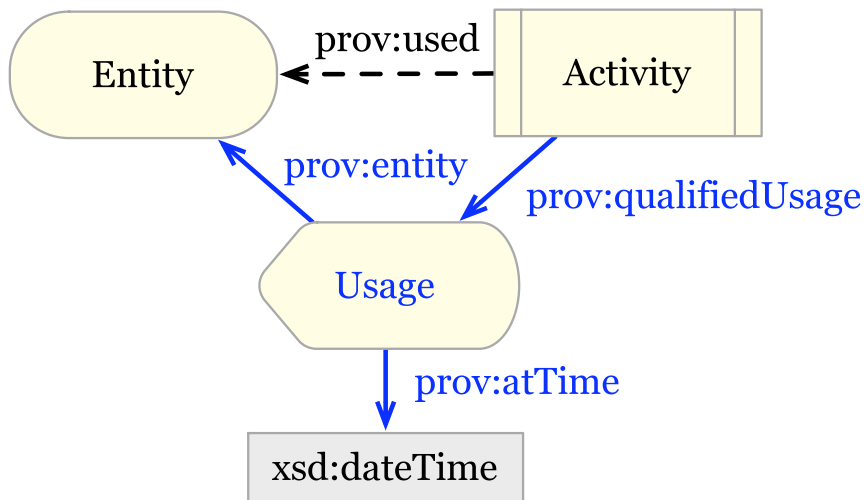
The Main Three Classes (1/3)



Qualification Pattern (2/3)

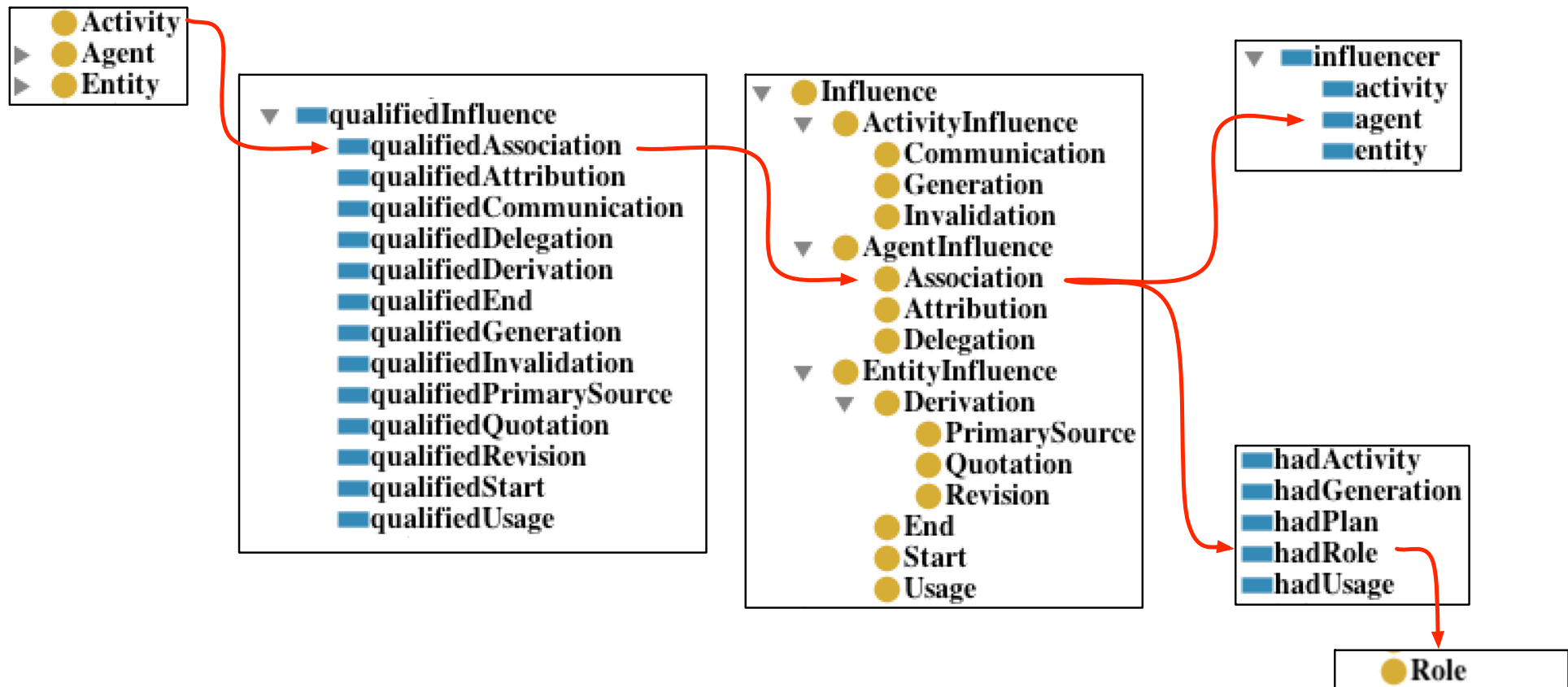
Elaborate 14 of the binary [Starting](#) and [Expanded](#) relationships

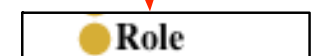
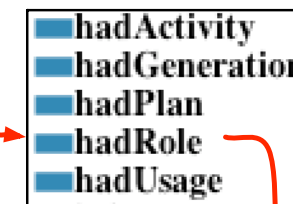
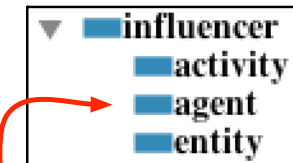
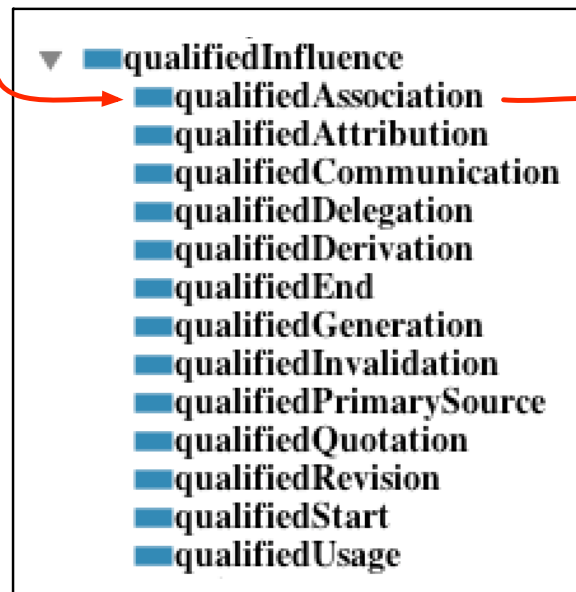
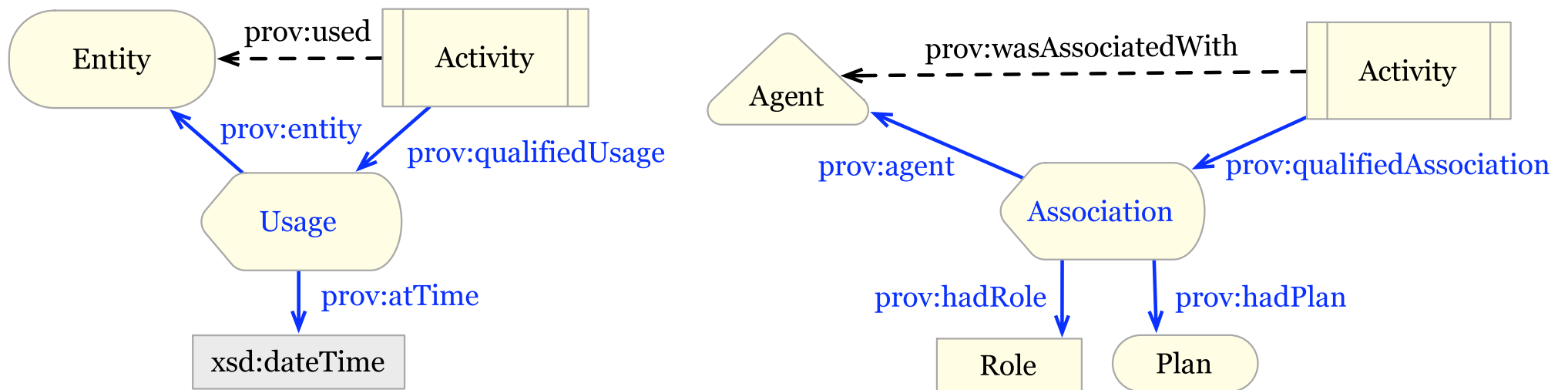




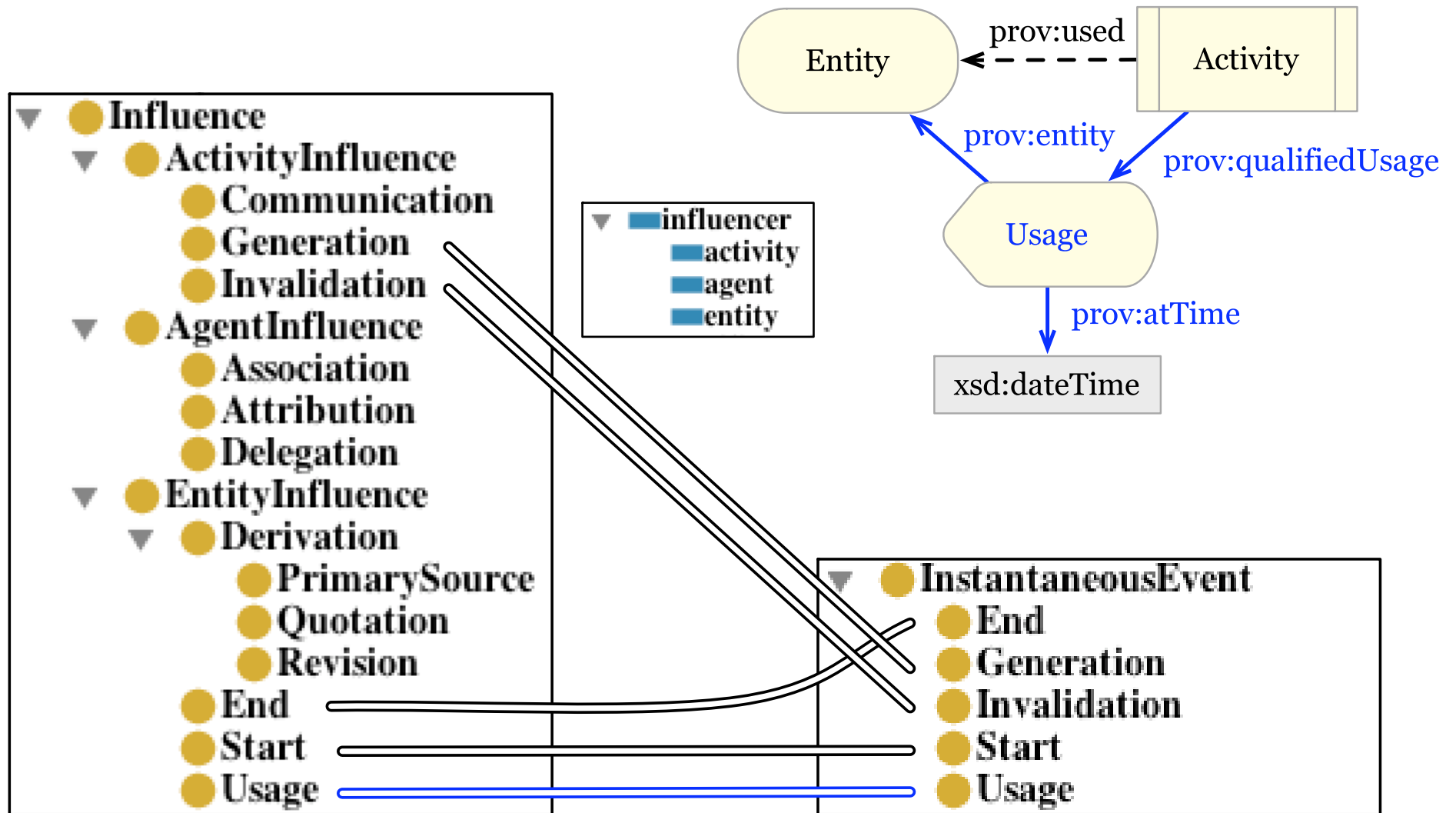
on Pattern (2/3)

ary **Starting** and **Expanded** relationships





Organizing Qualifications (3/3)



Acknowledgement

- Tim Lebo:
 - <http://tw.rpi.edu/instances/TimLebo>
- W3C PROV Team
 - <http://www.w3.org/2011/prov#prov-o-team>