Introduction to ODPs and first pattern examples

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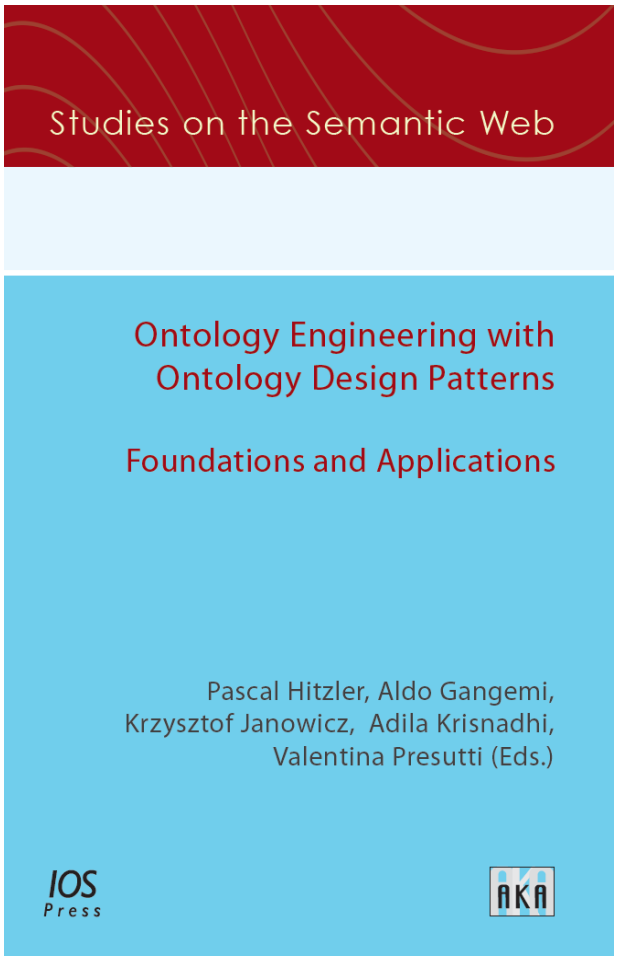
See IOS Press booth



Pascal Hitzler, Aldo Gangemi, Krzysztof Janowicz, Adila Krisnathi, Valentina Presutti (eds.),
Ontology Engineering with Ontology Design Patterns: Foundations and Applications.
Studies on the Semantic Web.
IOS Press/AKA Verlag, 2016.

25% off flyer at
http://ontologydesignpatterns.org/wiki/Odp:News/17

Supplementary material for the chess example at
http://dase.cs.wright.edu/content/pattern-driven-linked-data-publishing-primer

This Tutorial (all parts)

- **Pascal Hitzler (60 mins):**
  Introduction and first examples
- **Monika Solanki (30 mins):**
  Example "modeling vaccine traceability"

coffee

- **Pascal Hitzler (60 mins):**
  Example "GeoLink Modular Ontology"
- **Agnieszka Lawrynowicz (30 mins):**
  Example "Reporting Event ODP"

lunch

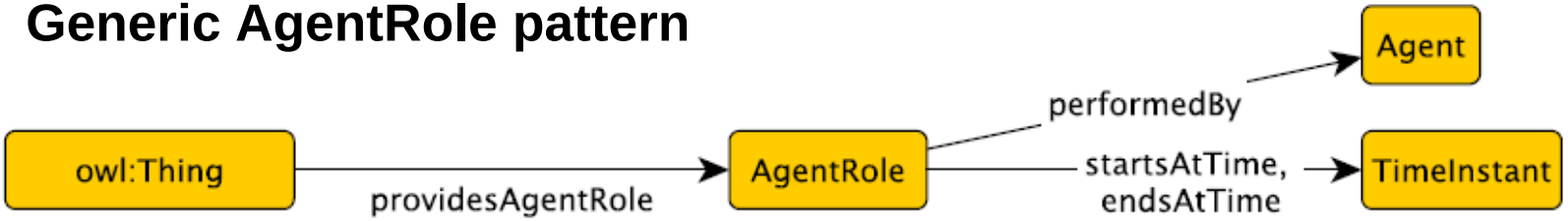
- **Karl Hammar with all others (3h):**
  Hands-on, the WebProtege XDP plug-in

What this is about

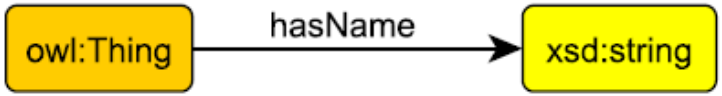
- A tutorial about ontology modeling best practices.
- Coming from the “Ontology Design Patterns” community.
- Recommended by us for all types of ontology modeling, including as graph schema for linked data and knowledge graphs.
- We are approaching a point where our experiences can consolidate into crisp recommendations, but we’re not quite there yet. I.e. there’s still work (and research) to be done.
- Join us if you’re interested:
  Google Group called “Ontology Design Patterns”

Very first example

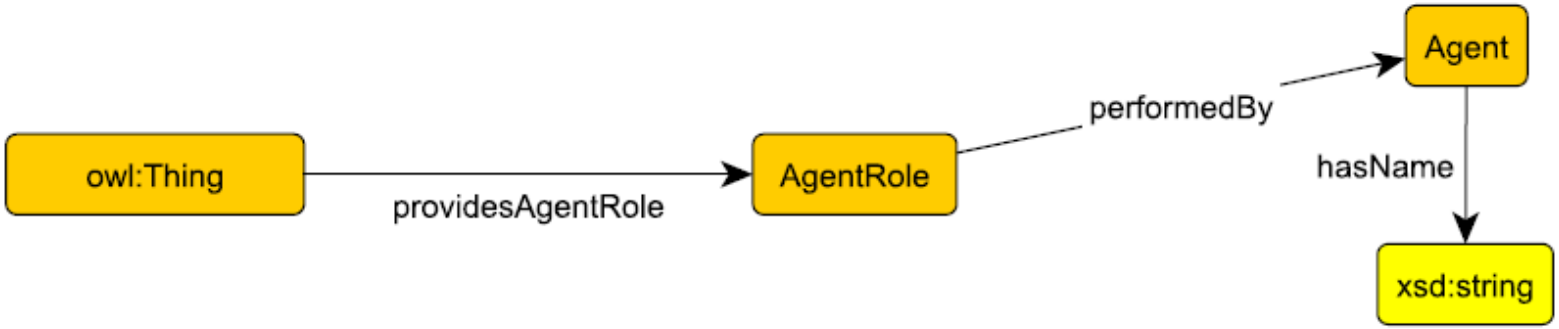
Generic AgentRole pattern



Generic NameStub pattern

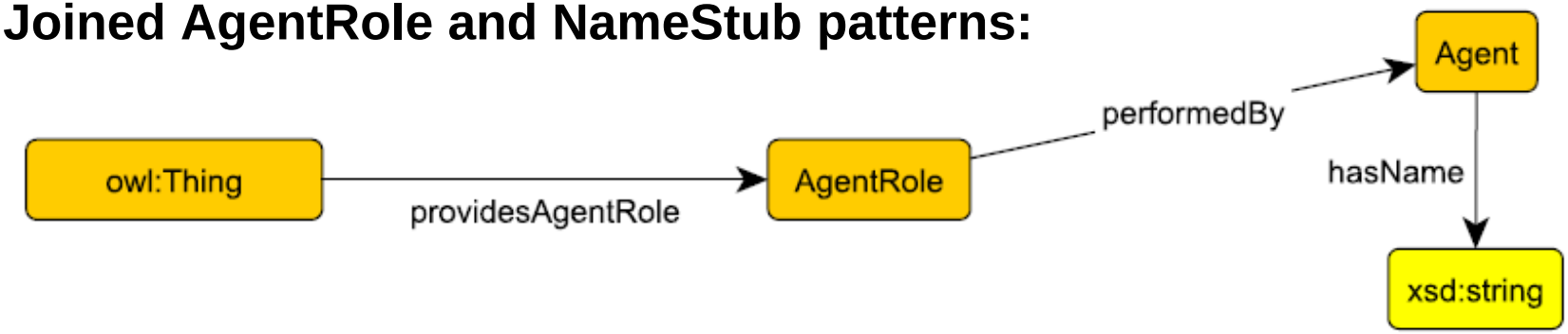


Joined:

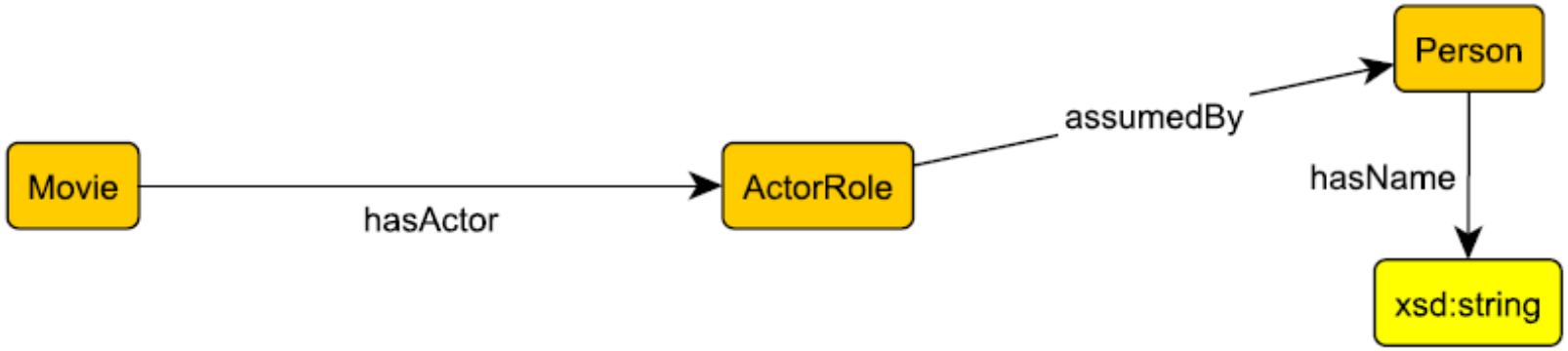


Very first example

Joined AgentRole and NameStub patterns:

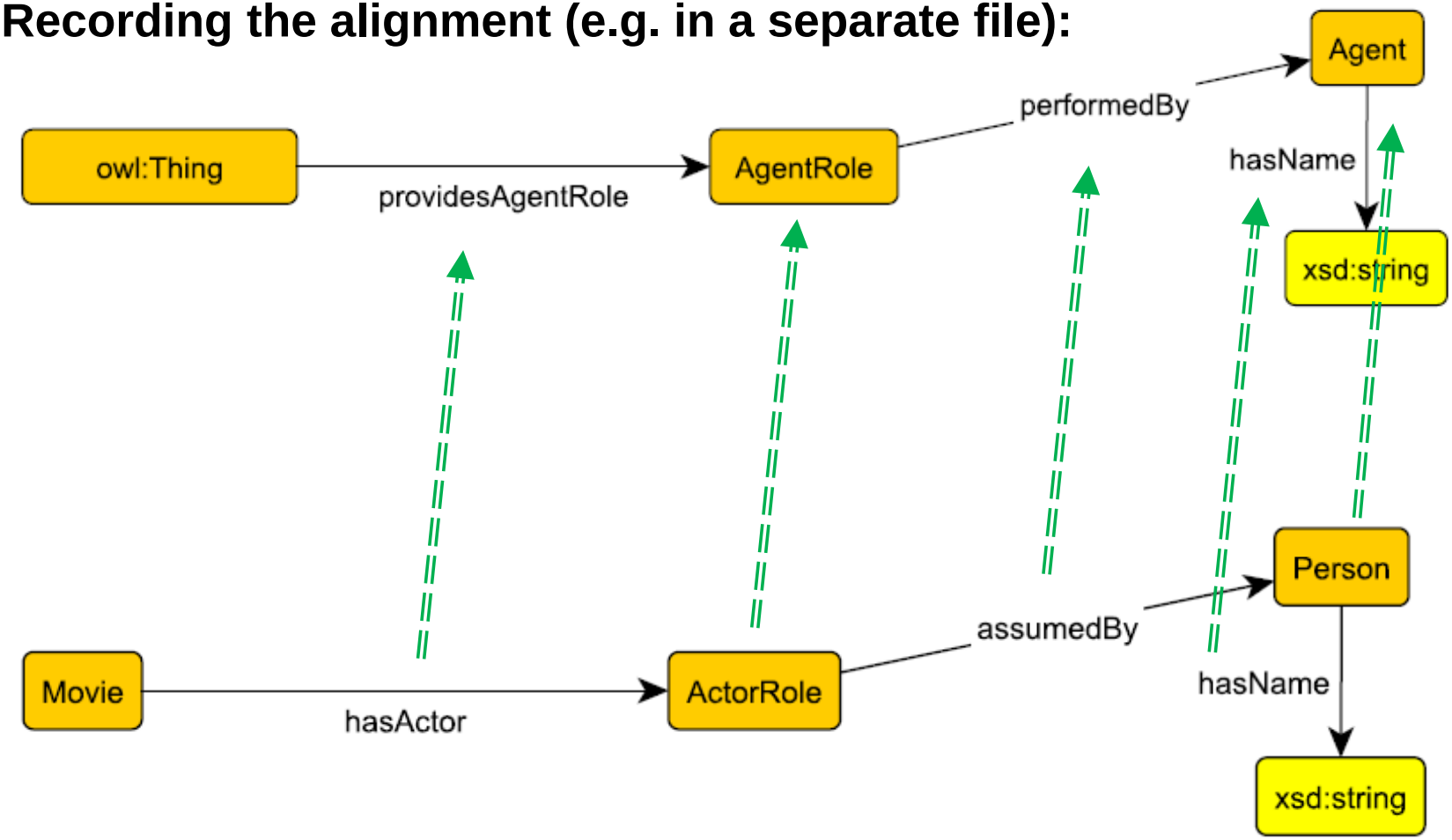


Used as a template for a concrete modeling problem:

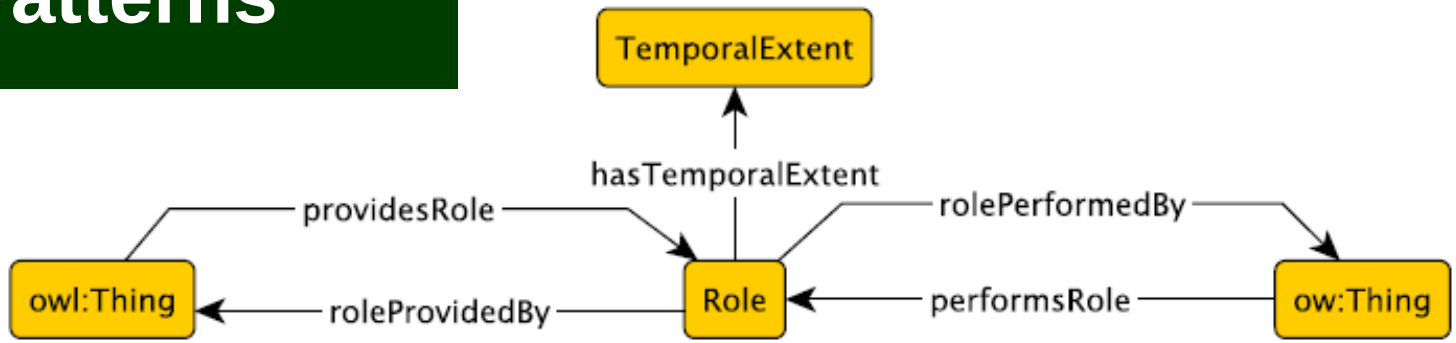


Very first example

Recording the alignment (e.g. in a separate file):

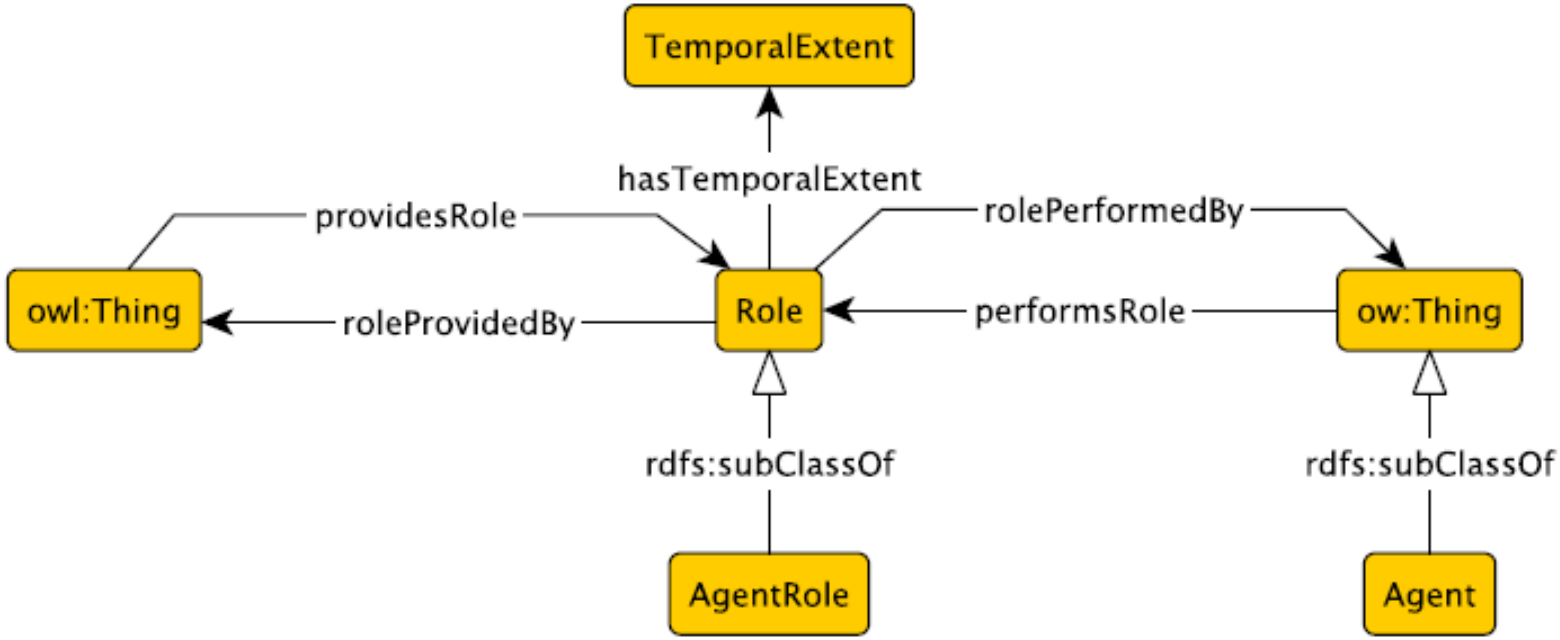


The Role Patterns



$\top \sqsubseteq \forall \text{providesRole}.\text{Role}$	range
$\exists \text{roleProvidedBy}.\top \sqsubseteq \text{Role}$	domain
$\text{providesRole} \equiv \text{roleProvidedBy}^-$	inverse
$\top \sqsubseteq \forall \text{performsRole}.\text{Role}$	range
$\exists \text{rolePerformedBy}.\top \sqsubseteq \text{Role}$	domain
$\text{rolePerformedBy} \equiv \text{performsRole}^-$	inverse
$\text{Role} \sqsubseteq \exists \text{hasTemporalExtent}.\text{TemporalExtent}$	existential
$\sqcap \forall \text{hasTemporalExtent}.\text{TemporalExtent}$	scoped range
$\sqcap (\leq 1\ \text{roleProvidedBy}.\top)$	range cardinality
$\sqcap (\leq 1\ \text{rolePerformedBy}.\top)$	range cardinality
$\text{Role} \sqsubseteq \exists \text{roleProvidedBy}.\top \sqcap \exists \text{rolePerformedBy}.\top$	existentials
$\texttt{DisjointClasses}(\text{Role}, \text{TemporalExtent})$	disjointness

The Agent Role Pattern



Axioms: all previous plus the following.

$$\text{AgentRole} \sqsubseteq \text{Role}$$

$$\exists \text{rolePerformedBy}.\text{Agent} \sqsubseteq \text{AgentRole}$$

$$\text{AgentRole} \sqsubseteq \forall \text{rolePerformedBy}.\text{Agent}$$

OWLAx

DaSe Lab

SSC

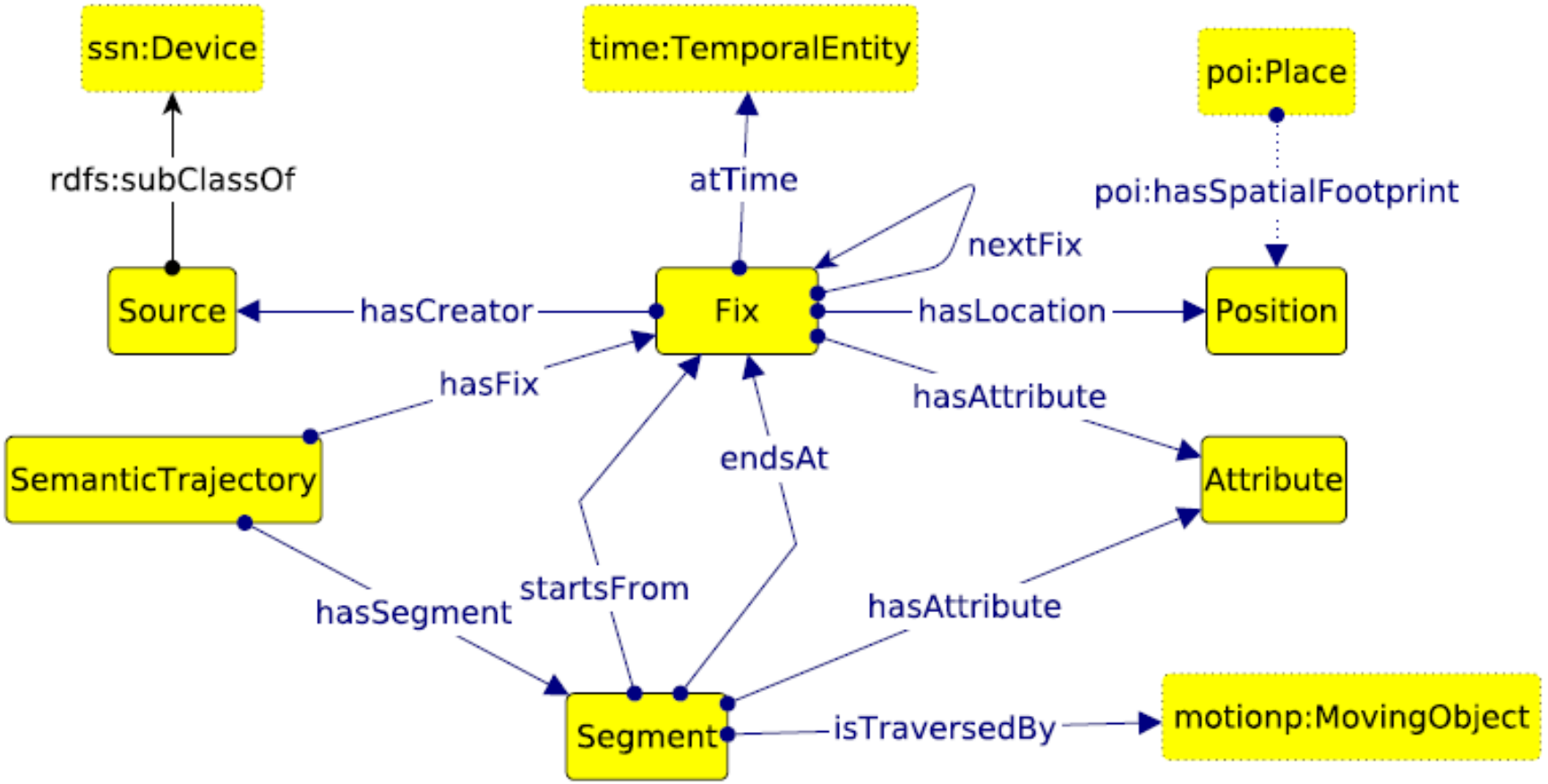
Ontology Axiomatization Support (OWLAx)

- **Protégé Plug-In**
- **Md. Kamruzzaman Sarker, Adila A. Krisnadhi, Pascal Hitzler, OWLAx: A Protege Plugin to Support Ontology Axiomatization through Diagramming. Proceedings Posters and Demos Track at ISWC 2016.**

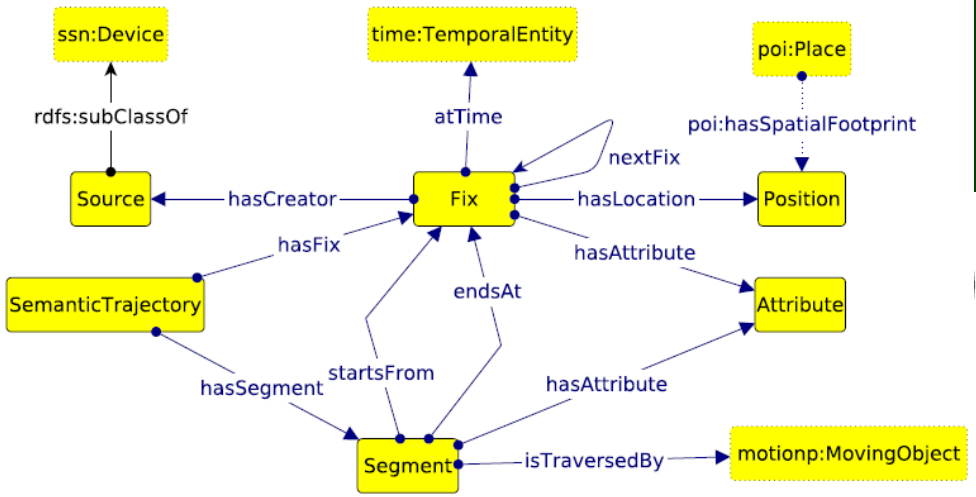
- **Insert class diagram using graphical UI**
- **System asks you whether to include corresponding axioms (taken from a pool of most common axioms for the diagram)**
- **You can of course also manually add further axioms.**

http://dase.cs.wright.edu/content/ontology-axiomatization-support

Trajectory pattern



Trajectory pattern



$$Fix \sqsubseteq \exists atTime.time{:}TemporalEntity \sqcap \exists hasLocation.Position \sqcap \exists hasFix^{-}.SemanticTrajectory$$

$$Segment \sqsubseteq \exists startsFrom.Fix \sqcap \exists endsAt.Fix$$

$$\top \sqsubseteq \leq 1 startsFrom.\top$$

$$\top \sqsubseteq \leq 1 endsAt.\top$$

$$Segment \sqsubseteq \exists hasSegment^{-}.SemanticTrajectory$$

$$startsFrom^{-} \circ endsAt \sqsubseteq hasNext$$

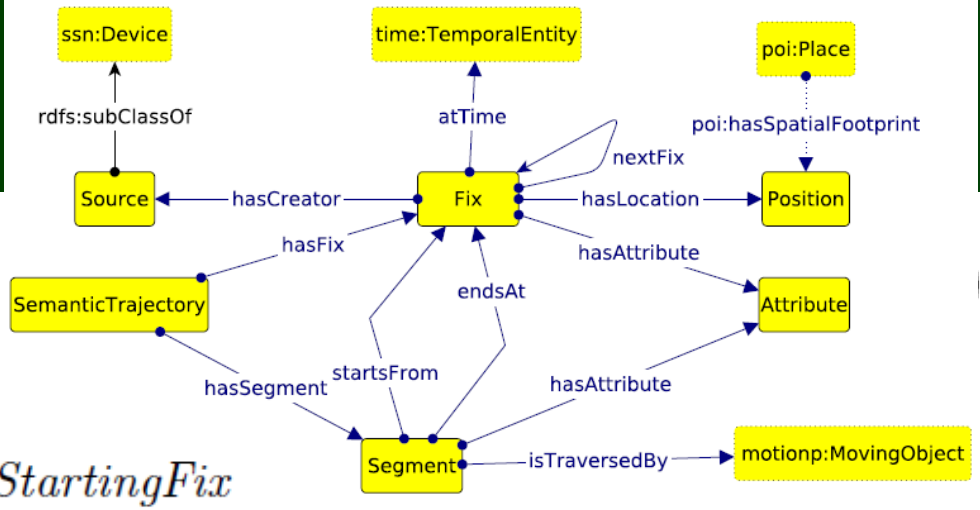
$$hasNext \sqsubseteq hasSuccessor$$

$$hasSuccessor \circ hasSuccessor \sqsubseteq hasSuccessor$$

$$hasNext^{-} \sqsubseteq hasPrevious$$

$$hasSuccessor^{-} \sqsubseteq hasPredecesor$$

Trajectory pattern



$$Fix \sqcap \neg \exists endsAt^{-}.Segment \sqsubseteq StartingFix$$

$$Fix \sqcap \neg \exists startsFrom^{-}.Segment \sqsubseteq EndingFix$$

$$Segment \sqcap \exists startsFrom.StartingFix \sqsubseteq StartingSegment$$

$$Segment \sqcap \exists endsAt.EndingFix \sqsubseteq EndingSegment$$

$$SemanticTrajectory \sqsubseteq \exists hasSegment.Segment$$

$$hasSegment \circ startsFrom \sqsubseteq hasFix$$

$$hasSegment \circ endsAt \sqsubseteq hasFix$$

$$\exists hasSegment.Segment \sqsubseteq SemanticTrajectory$$

$$\exists hasSegment^{-}.SemanticTrajectory \sqsubseteq Segment$$

$$\exists hasFix.Fix \sqsubseteq SemanticTrajectory$$

$$\exists hasFix^{-}.SemanticTrajectory \sqsubseteq Fix$$

Spatiotemporal Extent

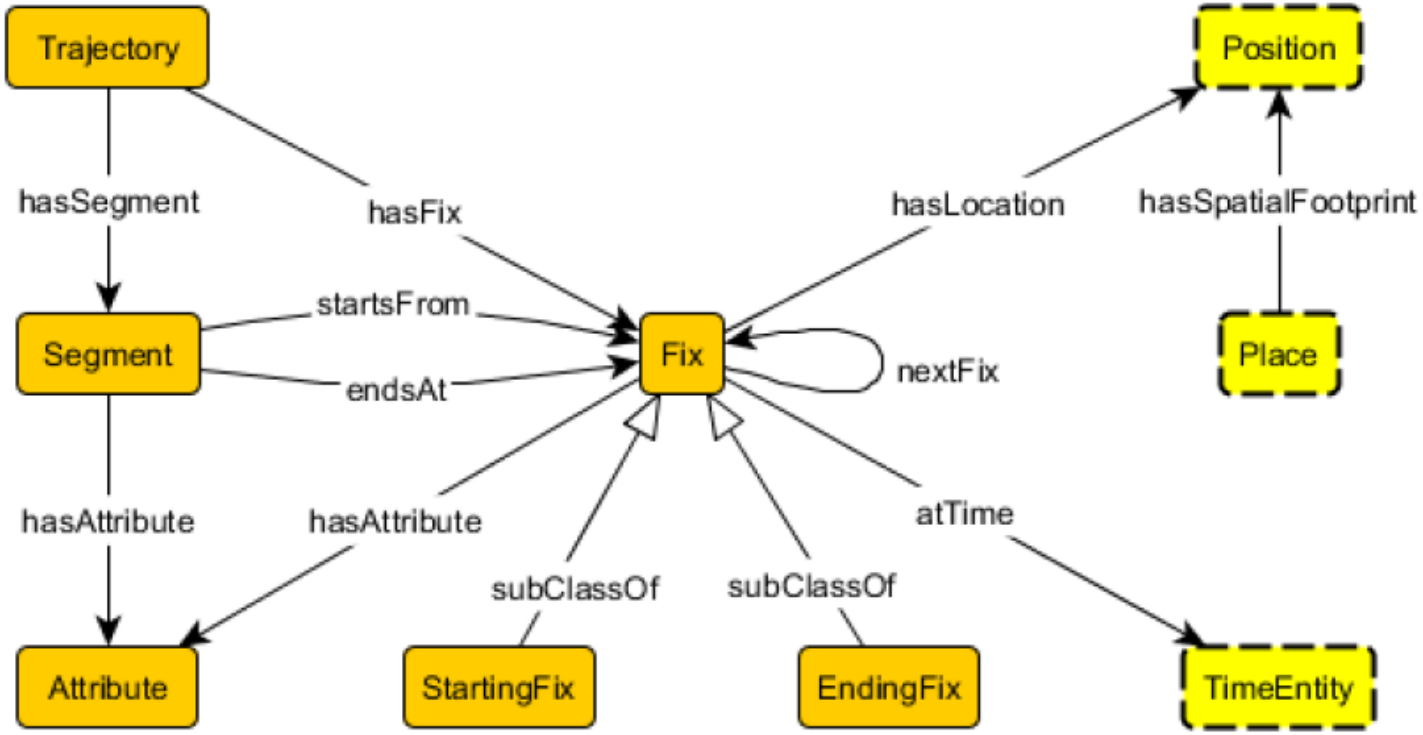


Fig. 1. Partial class diagram of the Trajectory Pattern from [2]. The dashed boxes indicate classes which are themselves (external) patterns, i.e., they need to be specified using a concrete module, or partial ontology.

Yingjie Hu, Krzysztof Janowicz, David Carral, Simon Scheider, Werner Kuhn, Gary Berg-Cross, Pascal Hitzler, Mike Dean, Dave Kolas, A Geo-Ontology Design Pattern for Semantic Trajectories. In: Thora Tenbrink, John G. Stell, Antony Galton, Zena Wood (Eds.): Spatial Information Theory - 11th International Conference, COSIT 2013, Scarborough, UK, September 2-6, 2013. Proceedings. Lecture Notes in Computer Science Vol. 8116, Springer, 2013, pp. 438-456.

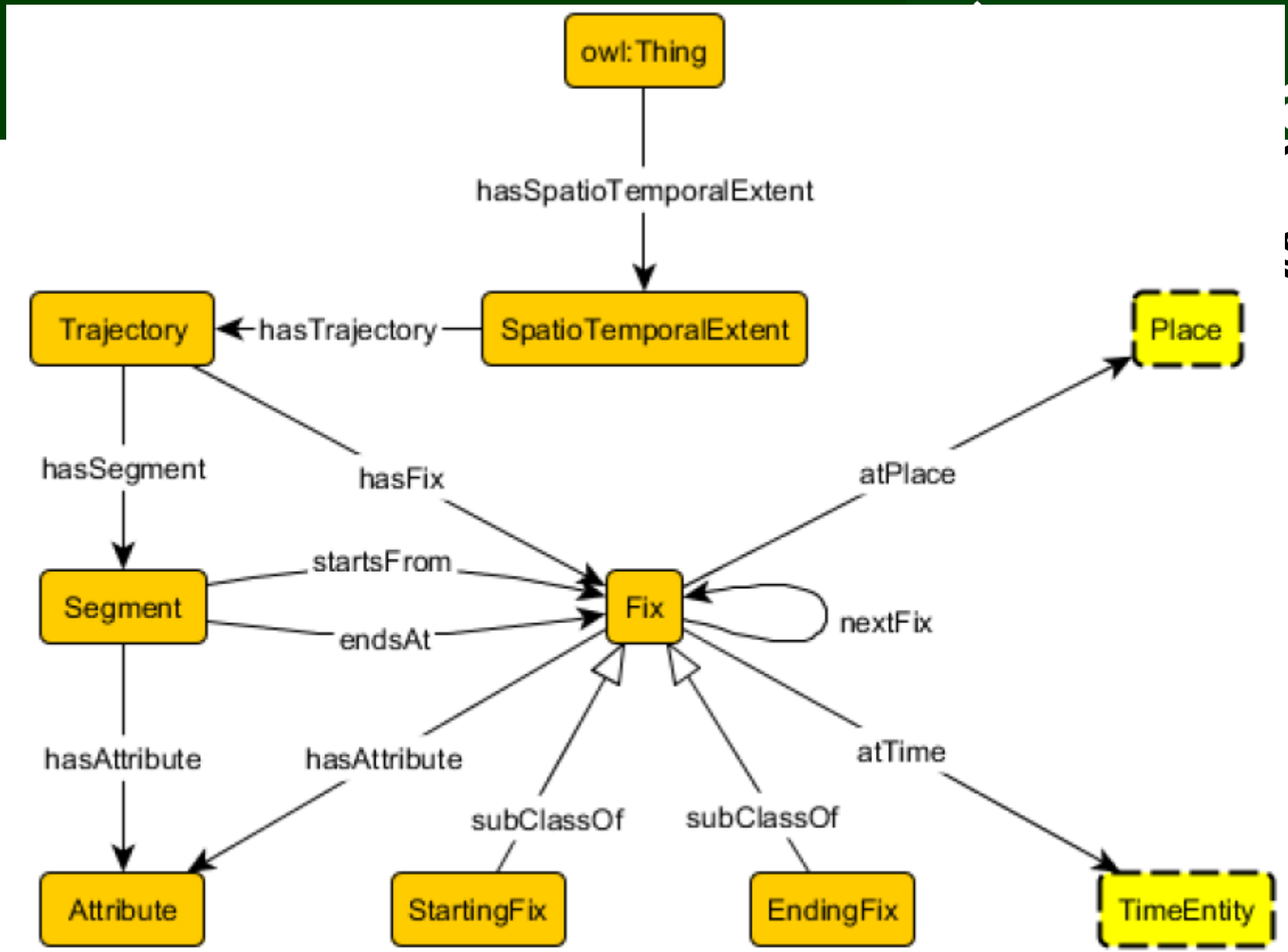


Fig. 2. Class diagram for the Spatiotemporal Extent pattern.

Axioms

Those inherited from the trajectory pattern, plus

$$\mathtt{SpatioTemporalExtent} \sqsubseteq \exists \mathtt{hasTrajectory}.\mathtt{Trajectory}$$

$$\mathtt{SpatioTemporalExtent} \sqsubseteq \forall \mathtt{hasTrajectory}.\mathtt{Trajectory}$$

$$\top \sqsubseteq \forall \mathtt{hasSpatioTemporalExtent}.\mathtt{SpatioTemporalExtent}$$

Spatiotemporal Extent

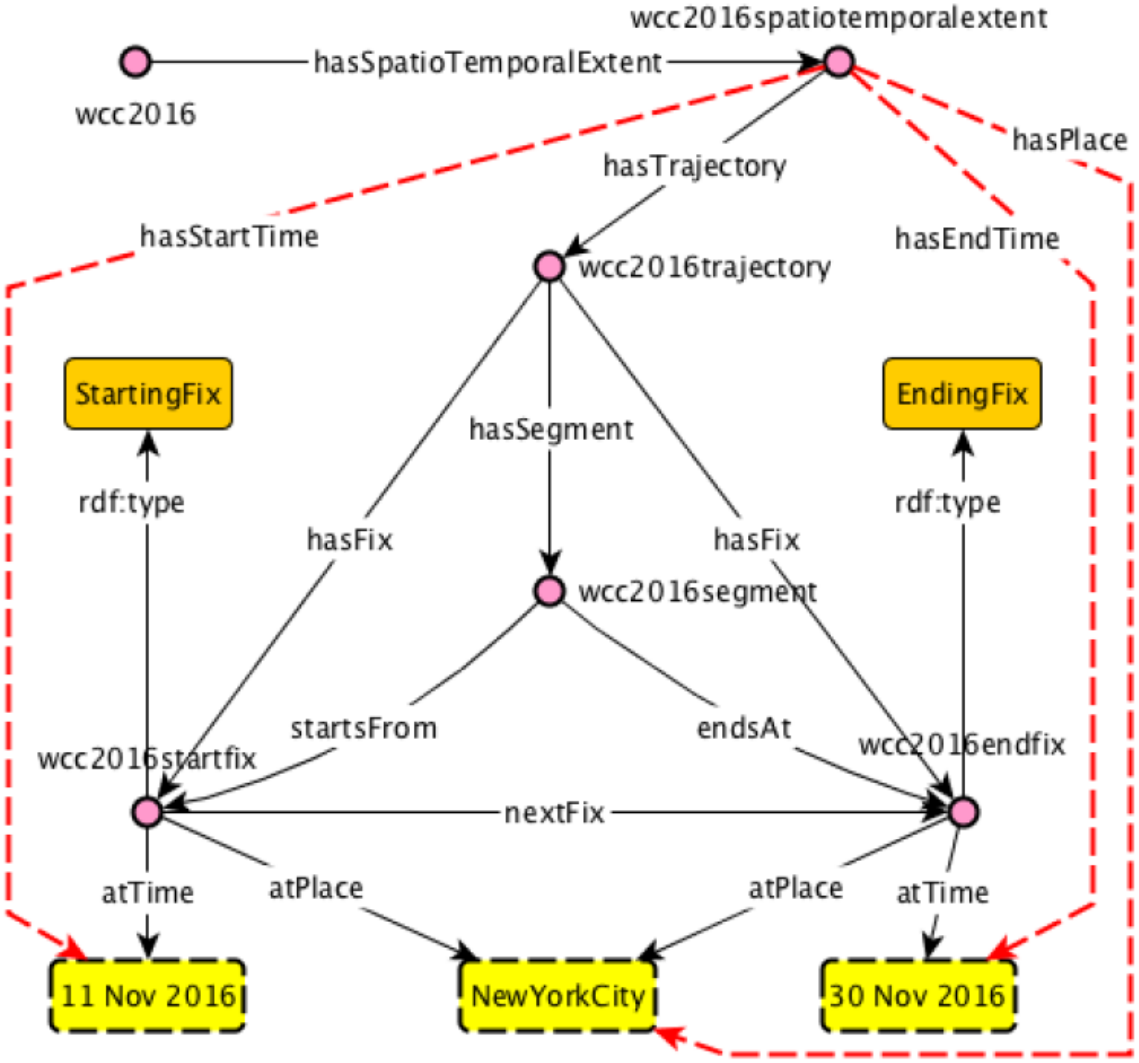


Fig. 3. Example for stationary trajectory: World Chess Championship 2016. The dashed red arrows indicate so-called shortcuts, which are discussed in the text.

Spatiotemp. Extent

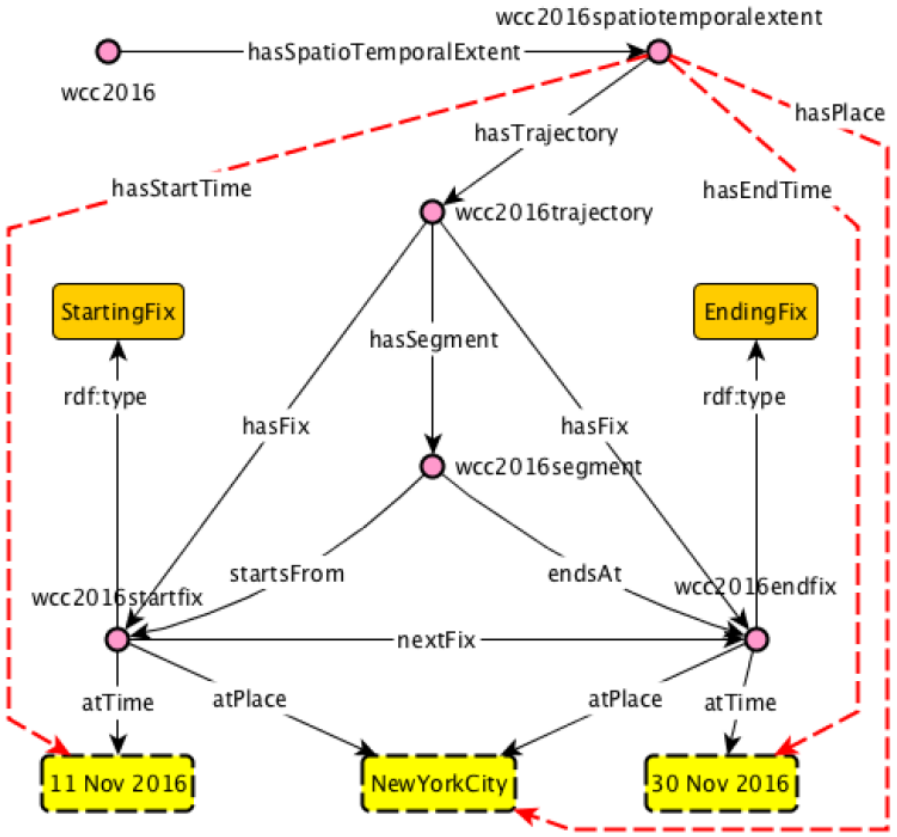


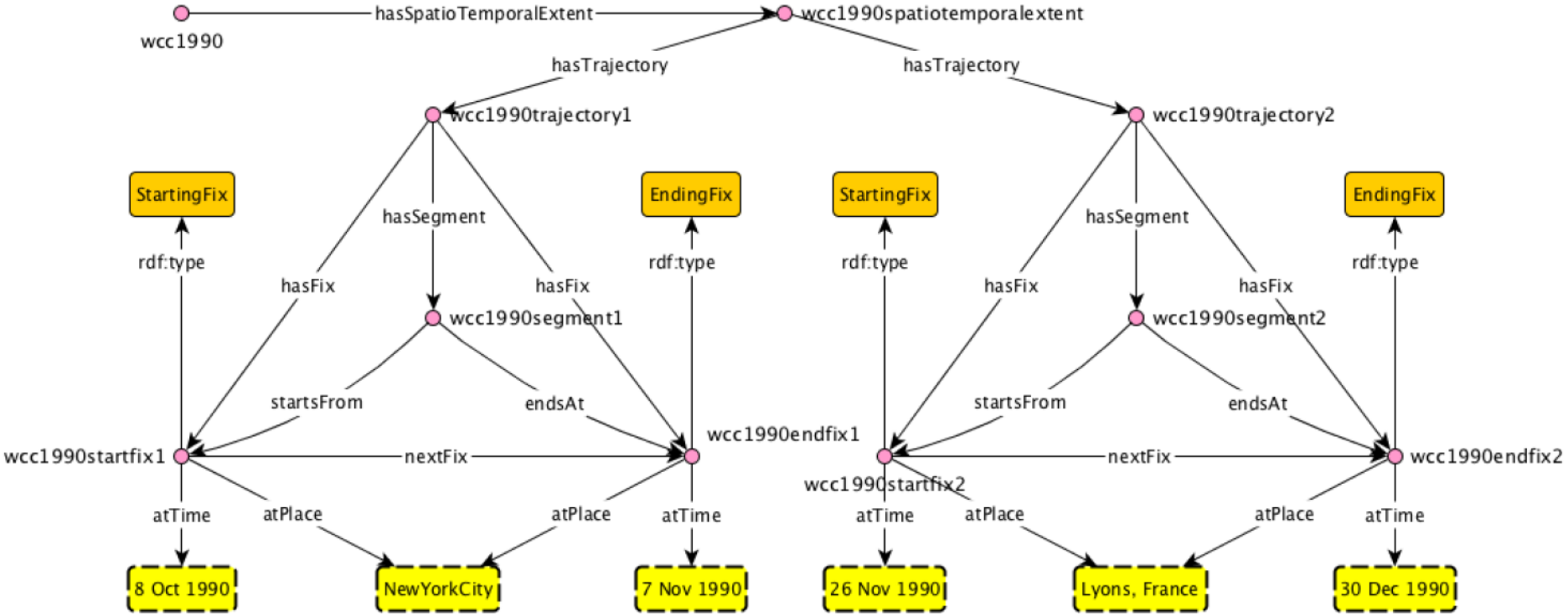
Fig. 3. Example for stationary trajectory: World Chess Championship 2016. The dashed red arrows indicate so-called shortcuts, which are discussed in the text.

$$\texttt{SpatioTemporalExtent}(x) \wedge \texttt{hasTrajectory}(x, y) \wedge \texttt{hasFix}(y, z) \wedge \texttt{StartingFix}(z) \wedge \texttt{atTime}(z, w) \rightarrow \texttt{hasStartTime}(x, w)$$

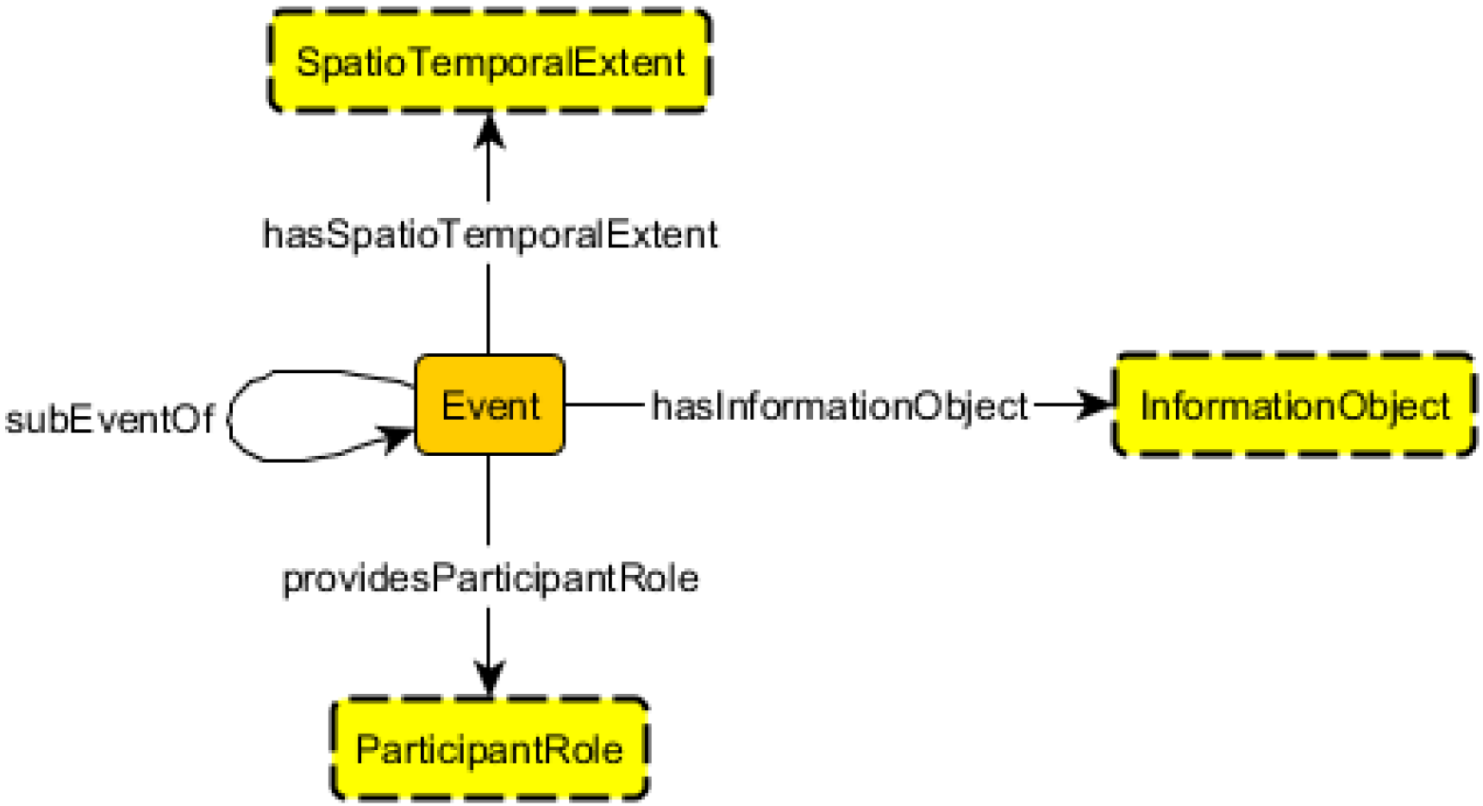
$$\texttt{SpatioTemporalExtent}(x) \wedge \texttt{hasTrajectory}(x, y) \wedge \texttt{hasFix}(y, z) \wedge \texttt{EndingFix}(z) \wedge \texttt{atTime}(z, w) \rightarrow \texttt{hasEndTime}(x, w)$$

$$\texttt{SpatioTemporalExtent}(x) \wedge \texttt{hasTrajectory}(x, y) \wedge \texttt{hasFix}(y, z) \wedge \texttt{atPlace}(z, w) \rightarrow \texttt{hasPlace}(x, w)$$

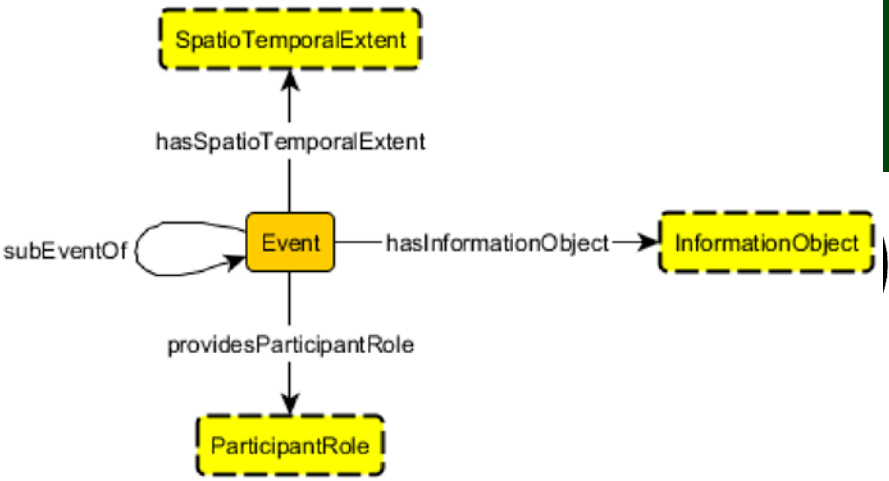
Spatiotemporal Extent



Spatiotemporal event



Spatiotemporal event



$$\text{subEventOf} \circ \text{subEventOf} \sqsubseteq \text{subEventOf}$$

$$\exists \text{subEventOf}.\top \sqsubseteq \text{Event}$$

$$\top \sqsubseteq \forall \text{subEventOf}.\text{Event}$$

$$\text{Event} \sqsubseteq \exists \text{hasSpatioTemporalExtent}.\text{SpatioTemporalExtent}$$

$$\top \sqsubseteq \forall \text{hasSpatioTemporalExtent}.\text{SpatioTemporalExtent}$$

$$\text{Event} \sqsubseteq \exists \text{providesParticipantRole}.\text{ParticipantRole}$$

$$\top \sqsubseteq \forall \text{providesParticipantRole}.\text{ParticipantRole}$$

$$\text{Event}(x) \wedge \text{providesParticipantRole}(x, p) \wedge \text{subEventOf}(x, y) \rightarrow \text{providesParticipantRole}(y, p).$$

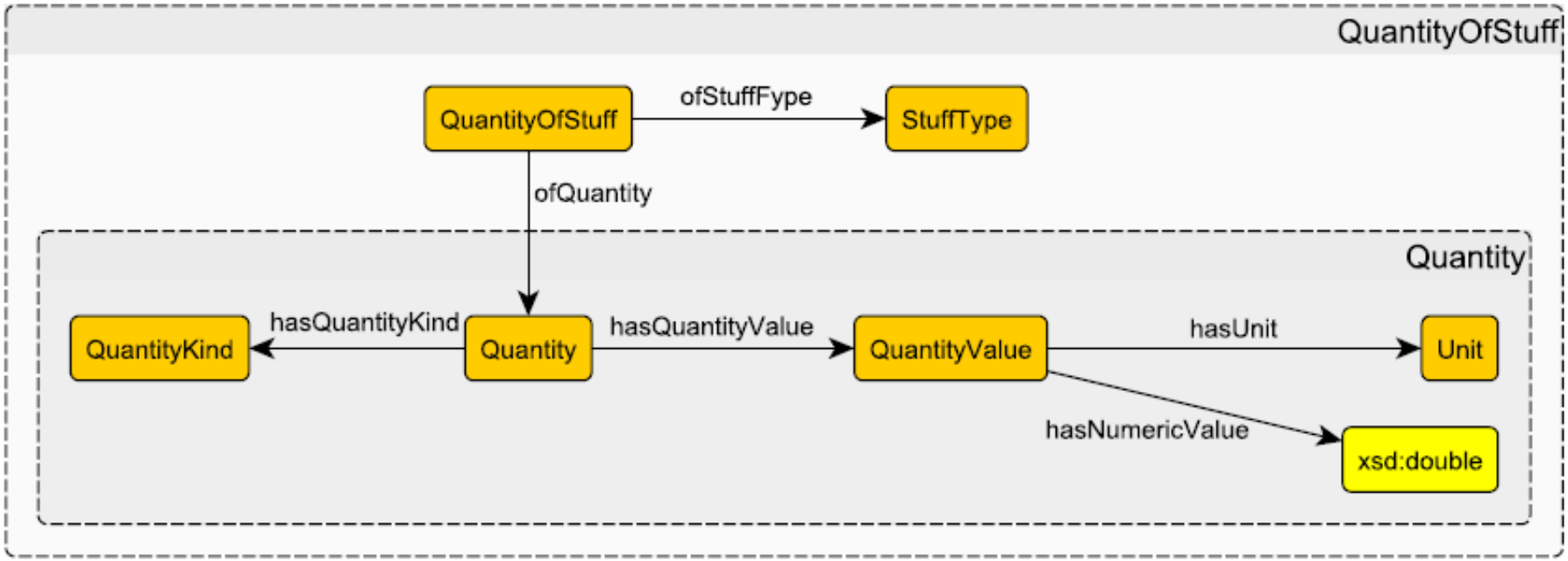
$$\text{Event}(x) \wedge \text{hasSpatioTemporalExtent}(x, w) \wedge \text{subEventOf}(x, y) \wedge \text{Event}(y) \wedge \text{hasSpatioTemporalExtent}(y, z) \rightarrow \text{subSTEOf}(w, z)$$

$$\top \sqsubseteq \forall \text{hasInformationObject}.\text{InformationObject}$$

$$\texttt{AllDisjointClasses}(\text{Event}, \text{SpatioTemporalExtent}, \text{ParticipantRole}, \text{InformationObject})$$

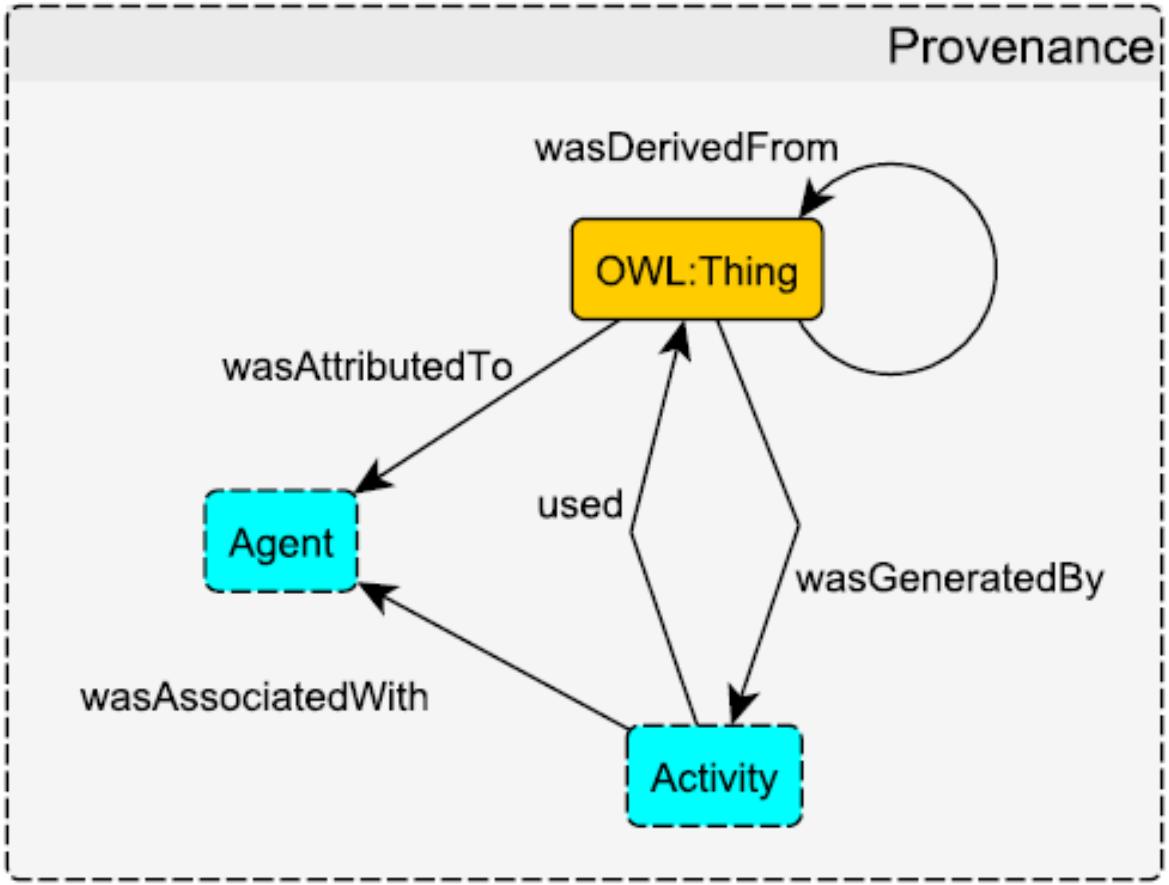
Quantities and Units

Borrowed from the QUDT ontology



Provenance

Borrowed from PROV-O



Thanks!

References

Pascal Hitzler, Aldo Gangemi, Krzysztof Janowicz, Adila Krisnathi, Valentina Presutti (eds.), Ontology Engineering with Ontology Design Patterns: Foundations and Applications. Studies on the Semantic Web. IOS Press/AKA Verlag, 2016/2017.

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Md Kamruzzaman Sarker, Adila A. Krisnadhi, David Carral, Pascal Hitzler, Rule-based OWL Modeling with ROWLTab Protege Plugin. In: Proceedings ESWC 2017. To appear.

Md. Kamruzzaman Sarker, David Carral, Adila A. Krisnadhi, Pascal Hitzler, Modeling OWL with Rules: The ROWL Protege Plugin In: Takahiro Kawamura, Heiko Paulheim (eds.), Proceedings of the ISWC 2016 Posters & Demonstrations Track co-located with 15th International Semantic Web Conference (ISWC 2016), Kobe, Japan, October 19, 2016. CEUR Workshop Proceedings 1690, CEUR-WS.org 2016.

Md. Kamruzzaman Sarker, Adila A. Krisnadhi, Pascal Hitzler, OWLAx: A Protege Plugin to Support Ontology Axiomatization through Diagramming, In: Takahiro Kawamura, Heiko Paulheim (eds.), Proceedings of the ISWC 2016 Posters & Demonstrations Track co-located with 15th International Semantic Web Conference (ISWC 2016), Kobe, Japan, October 19, 2016. CEUR Workshop Proceedings 1690, CEUR-WS.org 2016.