DaSe Lab

DaSe Lab: Some Advances in Semantic Web Technologies

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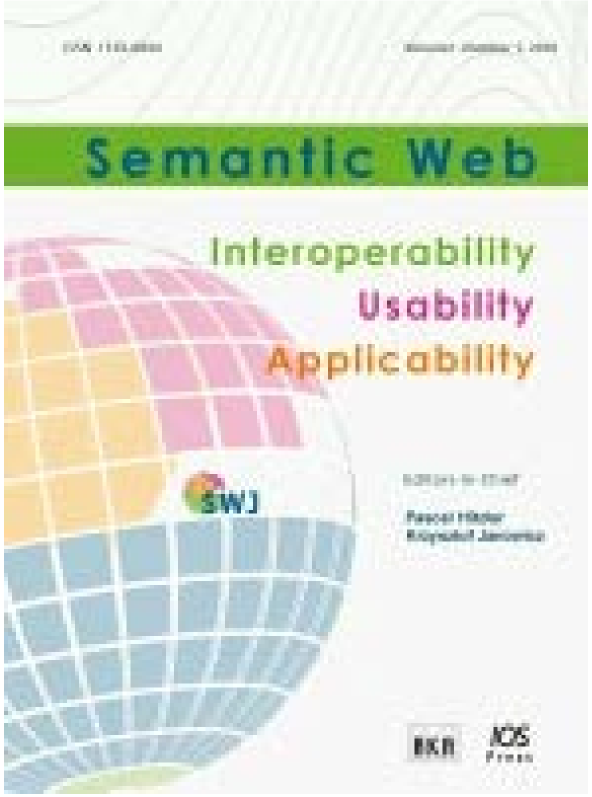
Semantic Web journal

DaSe Lab

- EiCs: Pascal Hitzler
  Krzysztof Janowicz
- Funded 2010
- SCImago ranks us 18th worldwide in Computer Science

- We very much welcome contributions at the “rim” of traditional Semantic Web research – e.g., work which is strongly inspired by a different field.
- Non-standard (open & transparent) review process.



- **http://www.semantic-web-journal.net/**

Semantic Web journal

2010 to 2015, using Publish or Perish, retrieved May 6, 2015

Journal	Papers	Citations	cites per paper	Cites per year	H-index
JWS	180	4234	23.5	847	36
SWJ	168	3122	18.6	624	30
AO	70	741	10.6	148	13
JDS*	53	447	8.4	112	10
IJSWIS	46	263	5.7	53	8

*** since 2011**

Semantic Web journal

Semantic Web journal ranking on SCImago

Submitted by Pascal Hitzler on 12/04/2014 - 12:08

The current (2013) SCImago journal and proceedings rankings for the Semantic Web journal are outstanding:

- Among all listed journals and conferences in Computer Science world-wide, the Semantic Web journal is ranked 18th, well ahead of other journals in the field. (reference)
- Among all listed journals and conferences in Computer Networks and Communications world-wide, the Semantic Web journal is ranked 2nd. (reference)
- Among all listed journals and conferences in Information Systems world-wide, the Semantic Web journal is ranked 3rd. (reference)
- Among all listed journals and conferences in Computer Science Applications world-wide, the Semantic Web journal is ranked 6th. (reference)

Semantic Web journal

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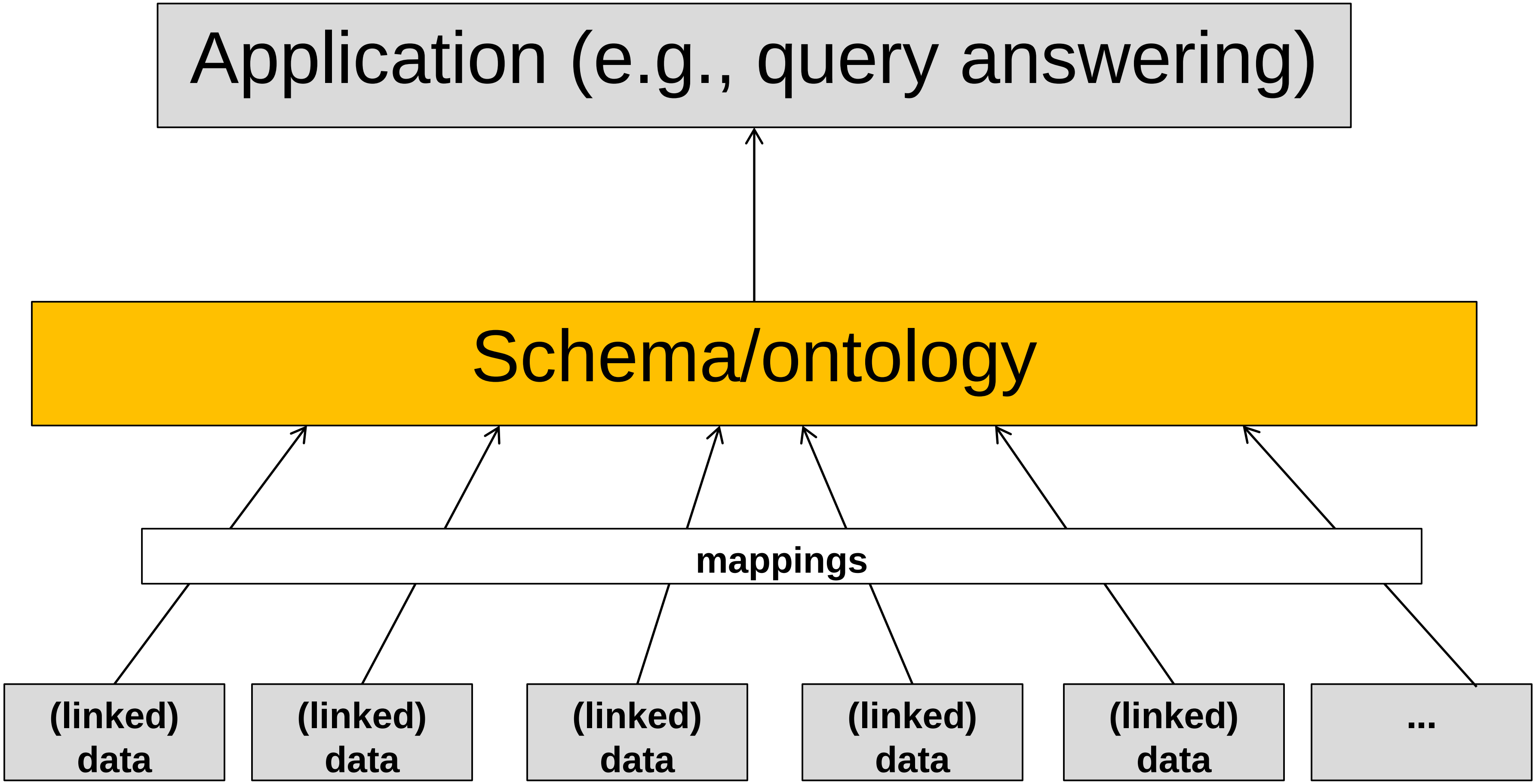
Transparent and open review process:

- **Papers posted online upon submission.**
- **Responsible editor publicly announced.**
- **Anybody can provide reviews (in addition to solicited reviews).**
- **Reviews are posted publicly online.**
- **Reviewer names are posted with the reviews (opt-out available).**
- **Reviewers and editors named together with published paper.**

Pascal Hitzler, Krzysztof Janowicz, The Semantic Web Journal Review Process: Transparent and Open. IEEE Computer Society Special Technical Community on Social Networking E-Letter 3 (1), 2015.

Krzysztof Janowicz, Pascal Hitzler, Open and transparent: the review process of the Semantic Web journal. Learned Publishing 25 (1), 48-55, 2012.

Semantic information integration



Making mappings [ISWC 2010]

- **BLOOMS: first alignment system which worked reasonably well for linked data schema.**
- **Produced subClassOf relationships**

Linked Open Data Schema Ontology Alignment

	Alignment API		OMViaUO		RiMoM		S-Match		AROMA		BLOOMS	
Test	Prec	Rec	Prec	Rec	Prec	Rec	Prec	Rec	Prec	Rec	Prec	Rec
M,B	0.4	0	1	0	err	err	0.04	0.28	0	0	0.63	0.78
M,D	0	0	0	0	err	err	0.08	0.30	0.45	0.01	0.39	0.62
F,D	0	0	0	0	err	err	0.11	0.40	0.33	0.04	0.67	0.73
G,D	0	0	0	0	err	err	0.23	1	0	0	0	0
S,F	0	0	0	0	0.3	0.2	0.52	0.11	0.30	0.20	0.55	0.64
W,A	0.12	0.05	0.16	0.03	err	err	0.06	0.4	0.38	0.03	0.42	0.59
W,D	0	0	0	0	err	err	0.15	0.50	0.27	0.01	0.70	0.40
Avg.	0.07	0.01	0.17	0	NA	NA	0.17	0.43	0.25	0.04	0.48	0.54

Trying it out

Federated querying set-up:

- **PROTON upper level ontology for integration**
- **BLOOMS ontology alignment system for making the mappings**
- **sameAs.org plus some crawling for co-reference resolution**

Works somewhat, but there are major issues, e.g.

- **The produced mappings are much too simplistic.**
- **Co-reference resolution is a serious issue.**
- **Structure and expressivity of the integration ontology is fixed.**

[ODBASE 2012]

Ontology alignment

State of ontology alignment:

- **Mostly string matching**
- **Property matching hardly works at all**

- **What we really need is complex mapping rules. There is hardly any work on automating this.**

Mostly string matching

[ISWC 2013]

Table 1. Results of strings only approaches and the competitors from the OAEI 2012 competition on the conference data set (left) and the anatomy data set (right)

Metric	Prec.	Recall	F-meas.
YAM++	0.81	0.69	0.75
LogMap	0.82	0.58	0.68
StringsOpt	**0.85**	**0.55**	**0.67**
StringsAuto	**0.79**	**0.57**	**0.66**
Optima	0.62	0.68	0.65
CODI	0.74	0.57	0.64
GOMMA	0.85	0.47	0.61
Wmatch	0.74	0.50	0.60
WeSeE	0.76	0.49	0.60
Hertuda	0.74	0.50	0.60
MaasMatch	0.63	0.57	0.60
LogMapLt	0.73	0.50	0.59
HotMatch	0.71	0.51	0.59
Baseline 2	0.79	0.47	0.59
ServOMap	0.73	0.46	0.56
Baseline 1	0.80	0.43	0.56
ServOMapLt	0.88	0.40	0.55

Metric	Prec.	Recall	F-meas.
GOMMA-bk	0.92	0.93	0.92
YAM++	0.94	0.86	0.90
CODI	0.97	0.83	0.89
StringsOpt	**0.88**	**0.87**	**0.88**
LogMap	0.92	0.85	0.88
GOMMA	0.96	0.80	0.87
StringsAuto	**0.86**	**0.84**	**0.85**
MapSSS	0.94	0.75	0.83
WeSeE	0.91	0.76	0.83
LogMapLt	0.96	0.73	0.83
TOAST*	0.85	0.76	0.80
ServOMap	1.00	0.64	0.78
ServOMapLt	0.99	0.64	0.78
HotMatch	0.98	0.64	0.77
AROMA	0.87	0.69	0.77
StringEquiv	1.00	0.62	0.77
Wmatch	0.86	0.68	0.76

Even property matching sucks

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[OM 2014]

System	Class Prec	Class Rec	Class Fms	Prop Prec	Prop Rec	Prop Fms
AML	0.86	0.62	0.72	1.00	0.20	0.33
AMLback	0.86	0.64	0.73	1.00	0.24	0.39
CIDER_CL	0.46	0.59	0.52	0.07	0.22	0.11
HerTUDA	0.84	0.56	0.67	0.26	0.20	0.23
HotMatch	0.81	0.57	0.67	0.24	0.20	0.22
IAMA	0.87	0.55	0.67	0.14	0.07	0.09
LogMap	0.82	0.65	0.73	0.62	0.28	0.39
MapSSS	0.74	0.59	0.66	0.00	0.00	0.00
ODGOMS	0.87	0.55	0.67	0.32	0.26	0.29
ODGOMS1_2	0.81	0.66	0.73	0.32	0.26	0.29
ServOMap_v104	0.74	0.65	0.69	0.00	0.00	0.00
StringsAuto	0.71	0.63	0.67	0.00	0.00	0.00
WeSeEMatch	0.85	0.54	0.66	0.50	0.02	0.04
WikiMatch	0.84	0.54	0.66	0.26	0.22	0.24
YAM++	0.82	0.71	0.76	0.68	0.57	0.62
Average	0.79	0.60	0.68	0.36	0.18	0.21

Table 1. Performance of the top 2013 OAEI competitors on classes versus properties

Dealing with bad mappings

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[Sengupta et al 2014, 2015]

$$a{:}hasWife \sqsubseteq a{:}hasSpouse \quad (1)$$

$$symmetric(a{:}hasSpouse) \quad (2)$$

$$\exists a{:}hasSpouse.a{:}Female \sqsubseteq a{:}Male \quad (3)$$

$$\exists a{:}hasSpouse.a{:}Male \sqsubseteq a{:}Female \quad (4)$$

$$a{:}hasWife(\text{a:john}, a{:}mary) \quad (5)$$

$$a{:}Male(a{:}john) \quad (6)$$

$$a{:}Female(a{:}mary) \quad (7)$$

$$a{:}Male \sqcap a{:}Female \sqsubseteq \bot \quad (8)$$

$$symmetric(b{:}hasSpouse) \quad (9)$$

$$b{:}hasSpouse(b{:}mike, b{:}david) \quad (10)$$

$$b{:}Male(b{:}david) \quad (11)$$

$$b{:}Male(b{:}mike) \quad (12)$$

$$b{:}Female(b{:}anna) \quad (13)$$

$$a{:}hasSpouse \equiv b{:}hasSpouse \quad (14)$$

$$a{:}Male \equiv b{:}Male \quad (15)$$

$$a{:}Female \equiv b{:}Female \quad (16)$$

Fig. 1. Running example with selected axioms.

Dealing with heterogeneity

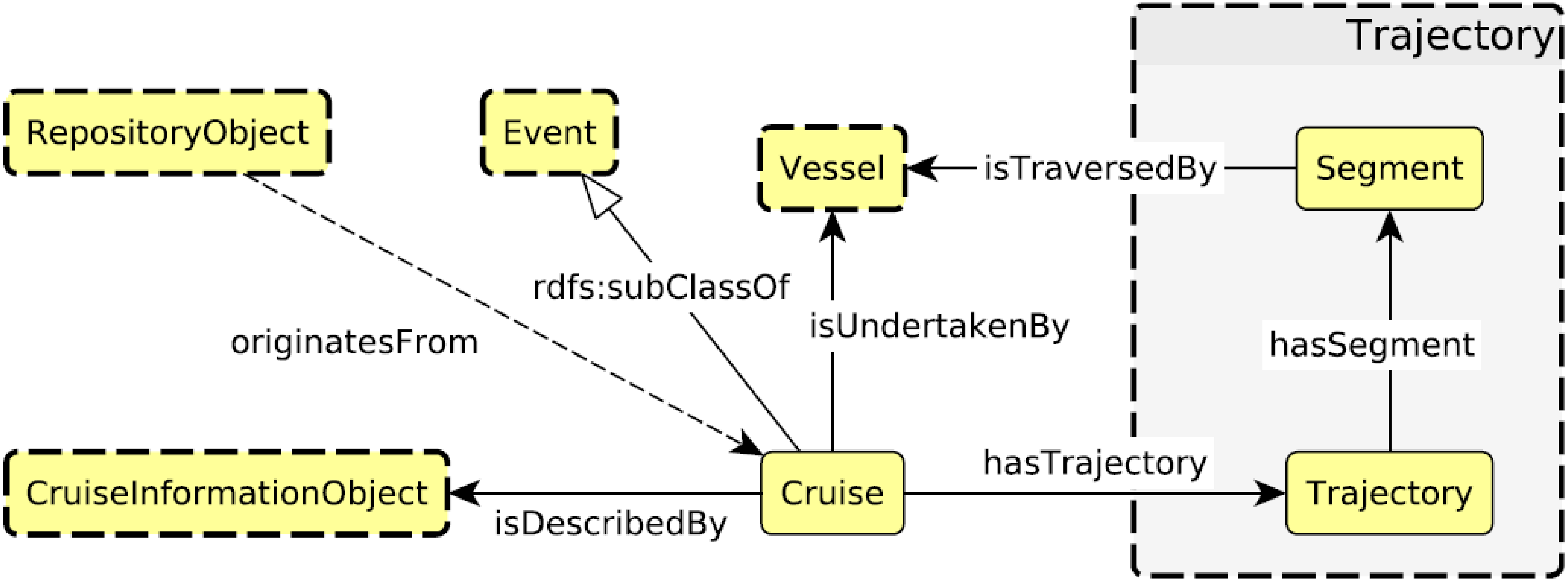
- **Ontological commitments:**
  Modeling choices you may regret later.

- **Ontological commitments are unavoidable.**
  They force very specific view points whenever you model an ontology.

- **So how can we make ontologies reusable?**

  Make them have “modules” which are “plug-and-playable”

Oceanographic Cruise



[ISWC 2015]

Roles (Cruise as Event)

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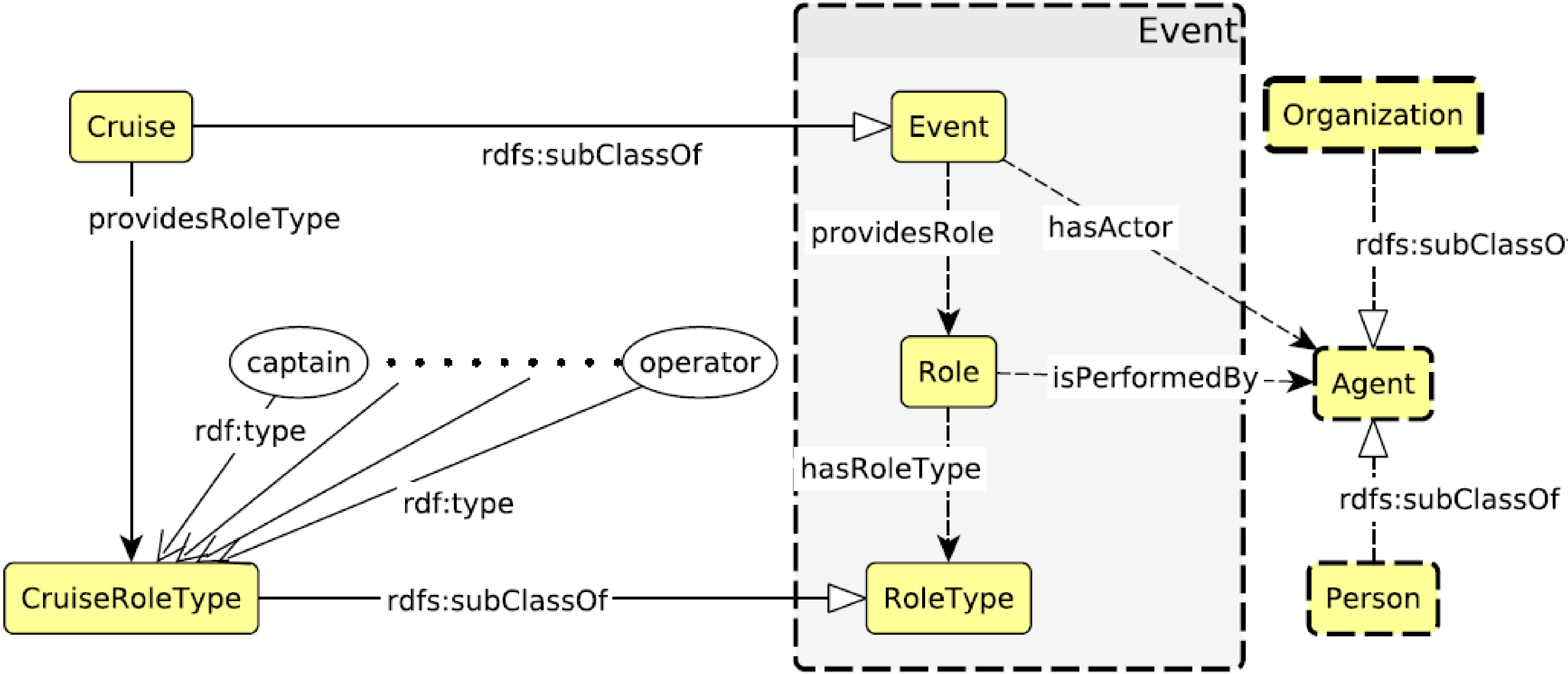
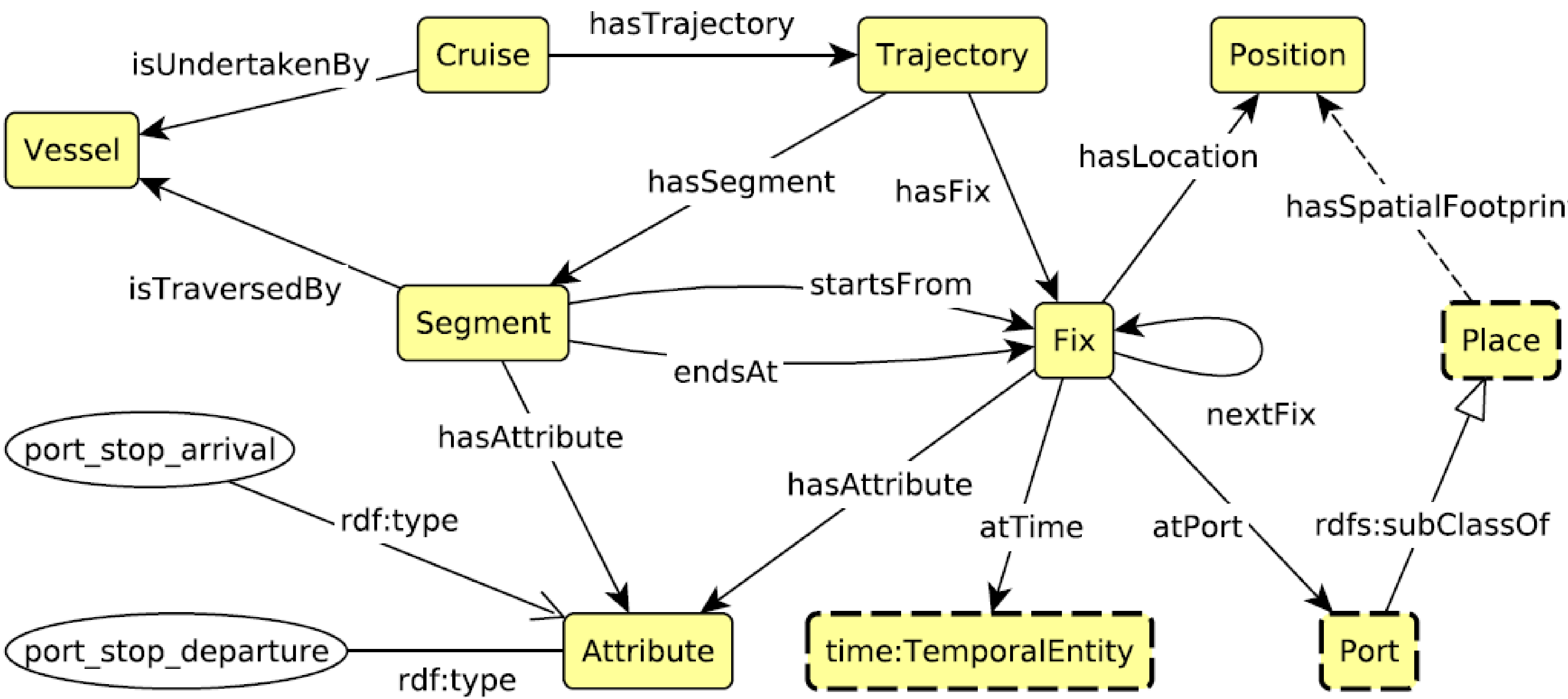
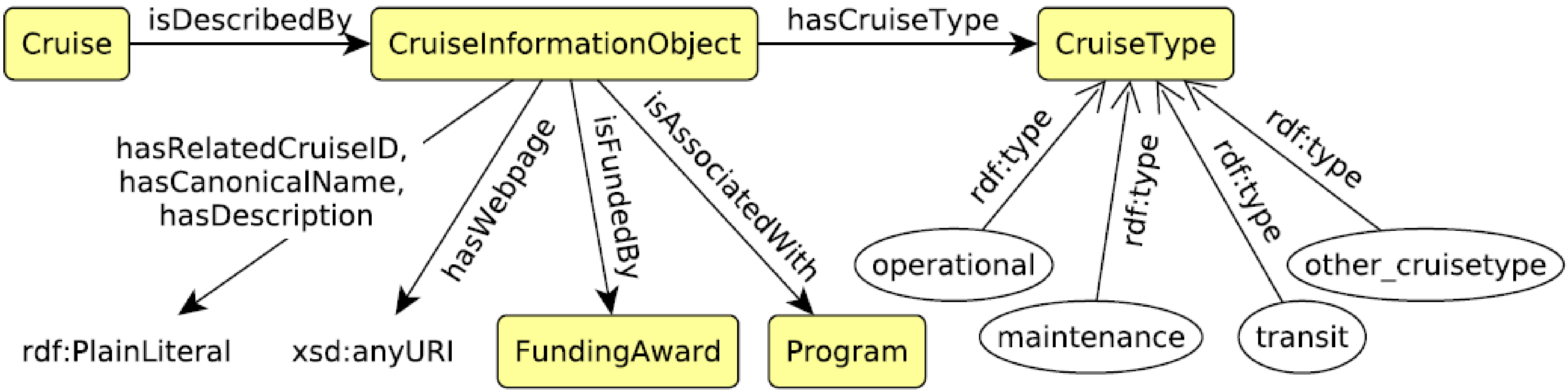


Cruise Trajectories

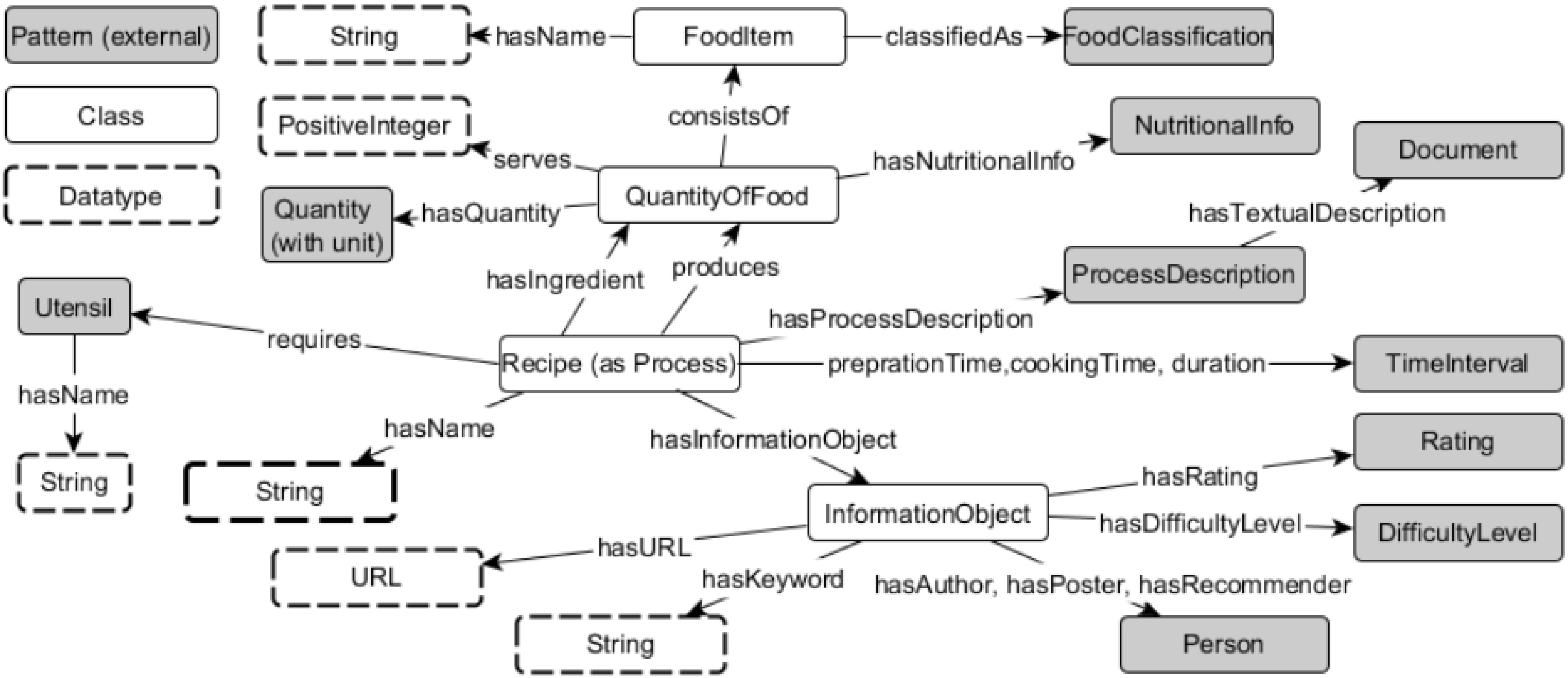


[COSIT 2013]

Information Objects

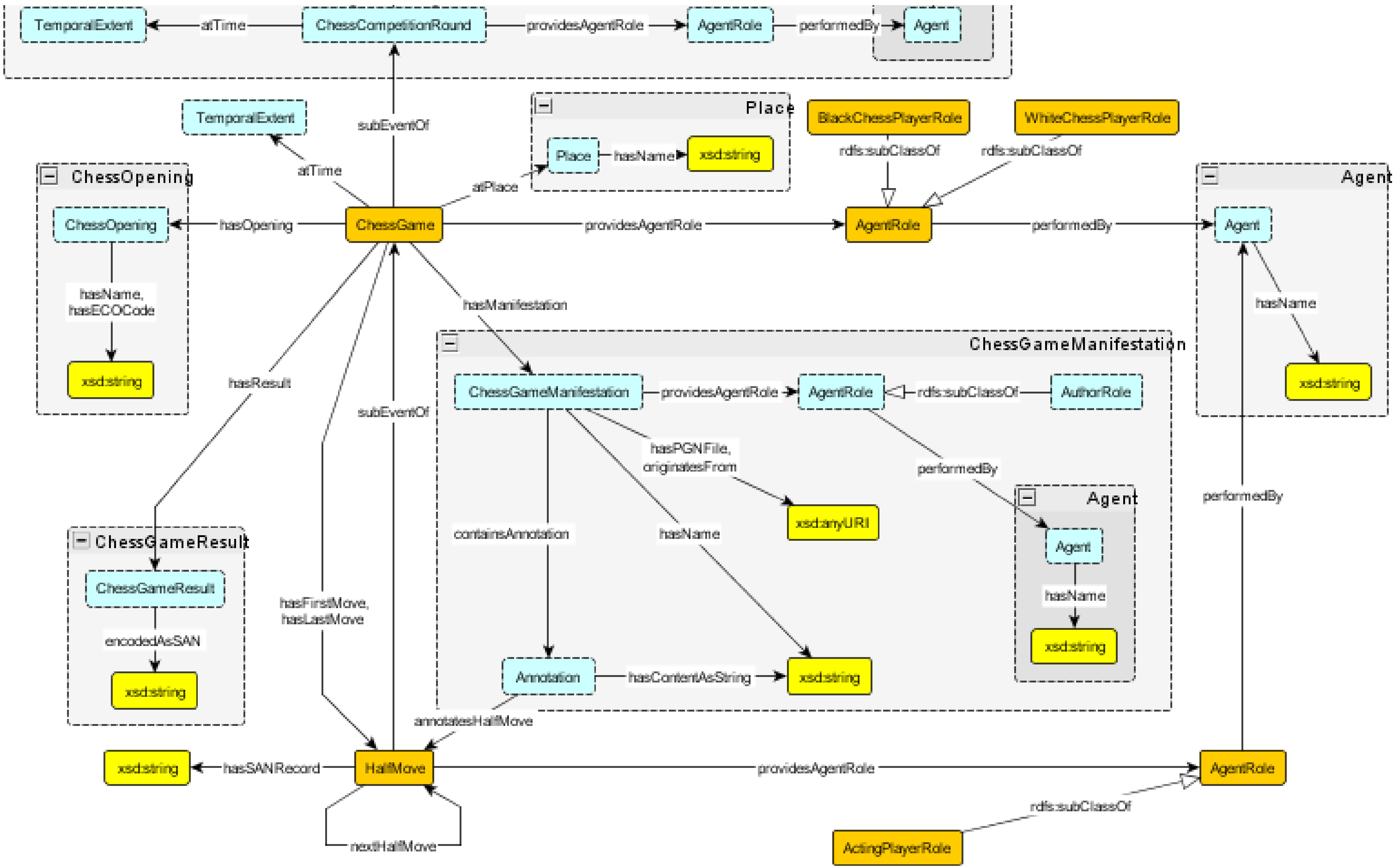


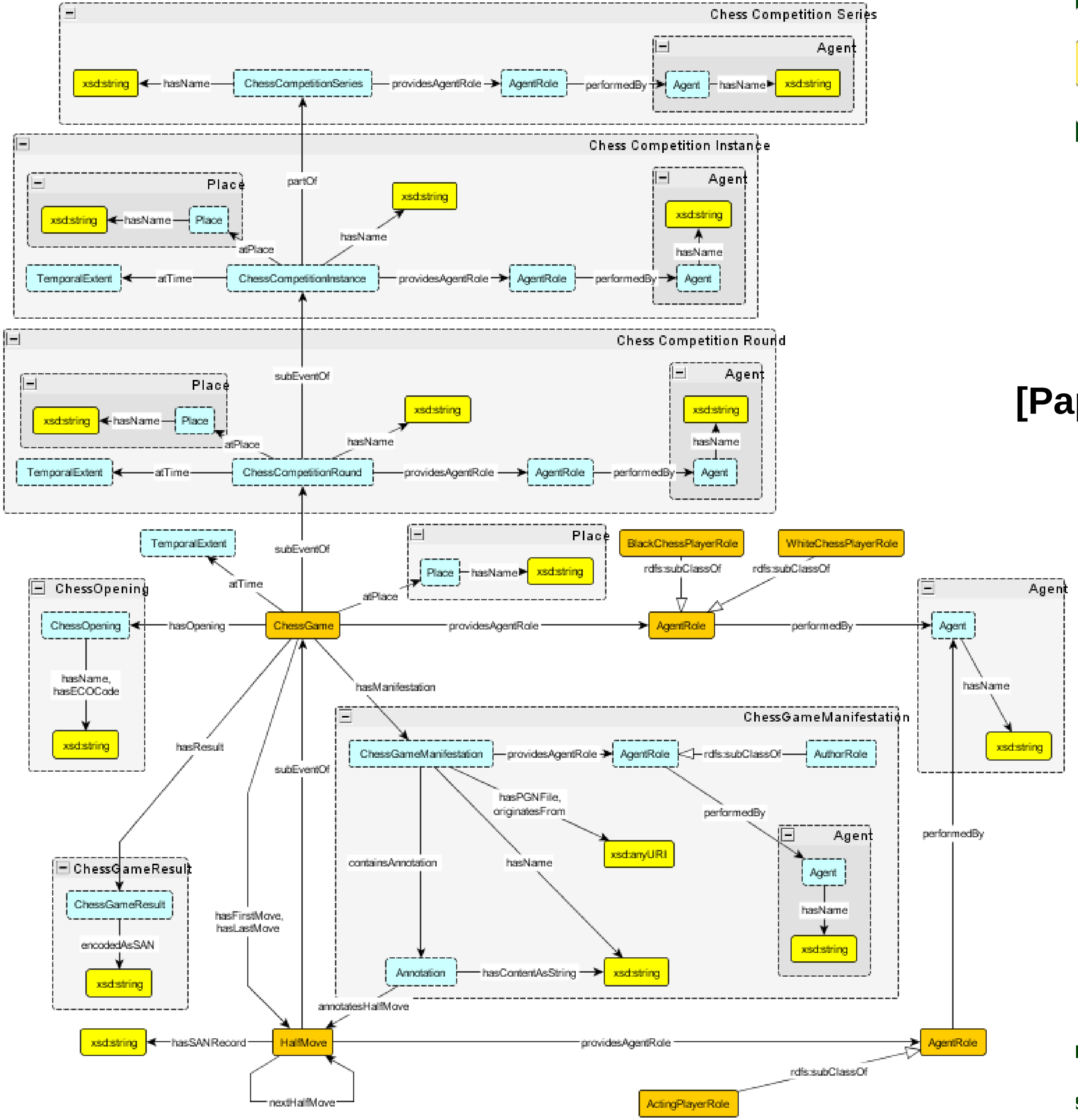
Recipes



[WOP 2014]

Chess Game Pattern





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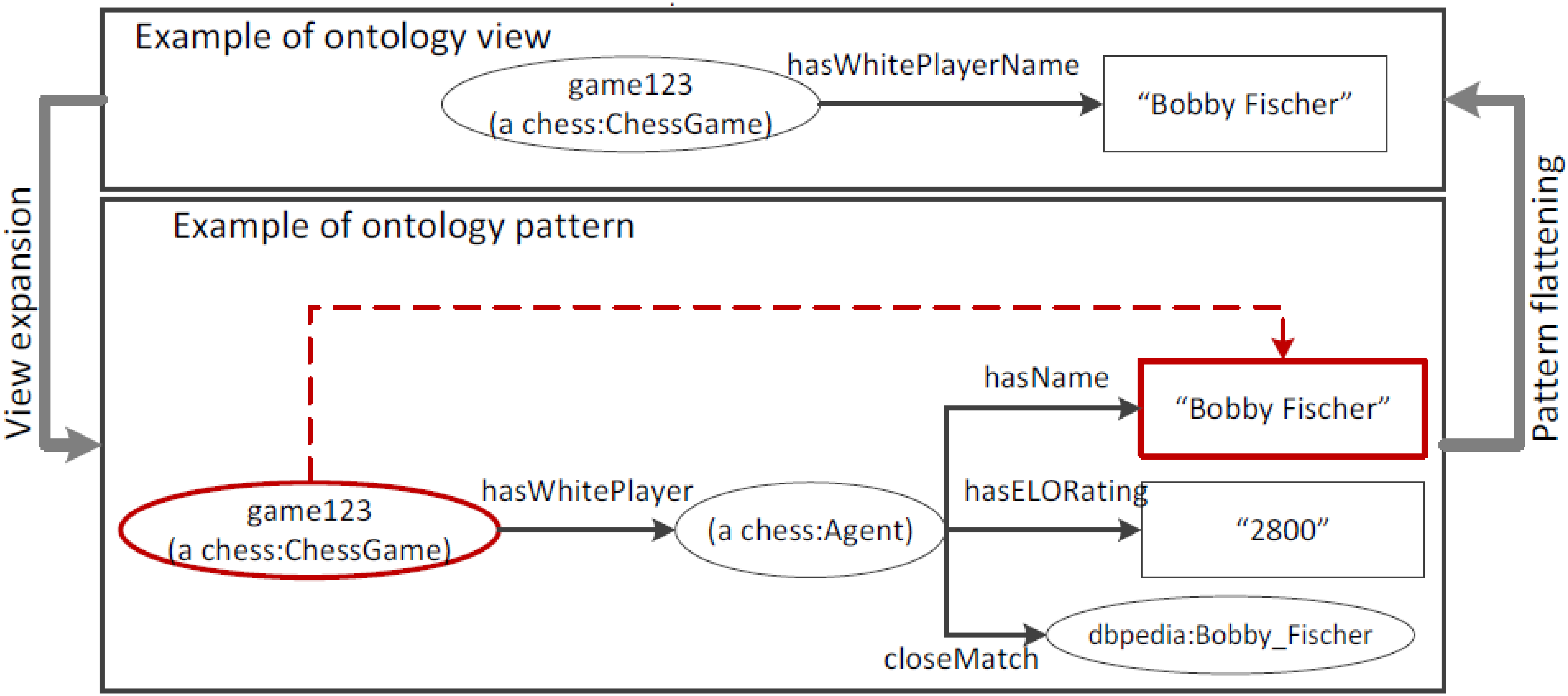
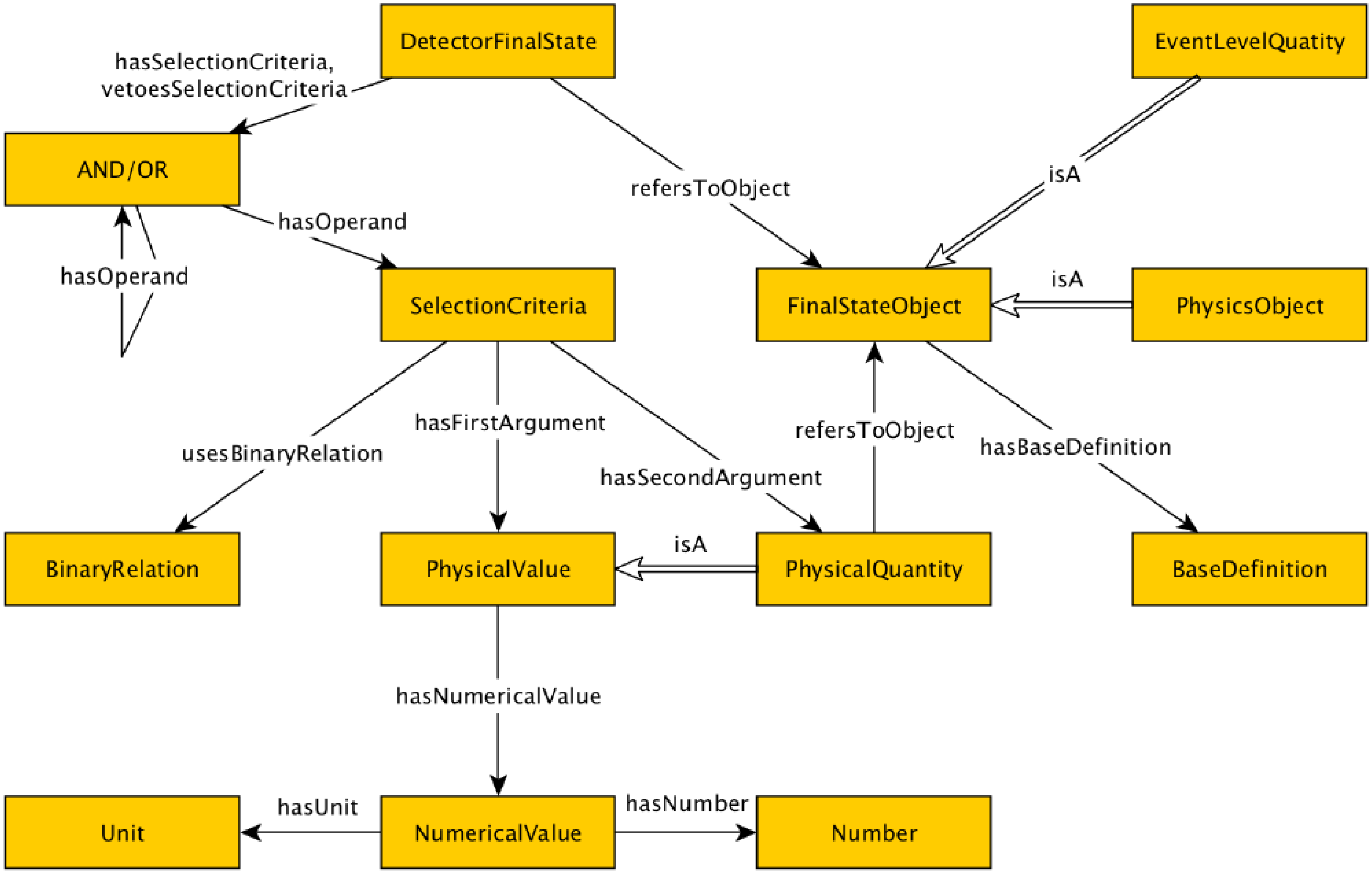
[Paper in preparation]

Views / shortcuts



Detector Final State



[Paper in preparation]

Material Transformation

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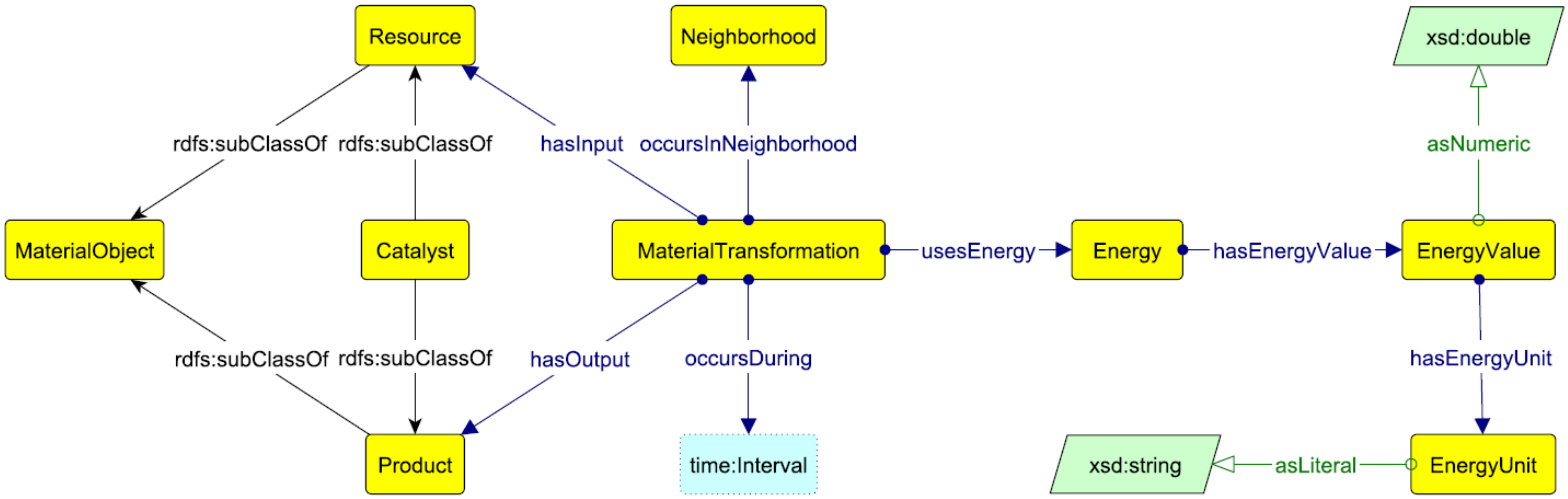

[Semantic Web journal, to appear]

Working at Scale

- Pushing tractrable (polynomial time) logics around OWL.
  - Stronger coverage of rules [WWW2011, RR2013].
  - Inverse roles in EL logics [IJCAR2014].
  - A larger Horn-DL recognized of being tractable (together with corresponding algorithm) [ISWC2014].

Distributed memory reasoning

- **Controlling communication overhead is central.**
  System for the logic EL: [ESWC2015]

	GO	SNOMED	SNOMEDx2	SNOMEDx3	SNOMEDx5	Traffic
Before	87,137	1,038,481	2,076,962	3,115,443	5,192,405	7,151,328
After	868,996	14,796,555	29,593,106	44,389,657	73,982,759	21,840,440

Table 2: Number of axioms, before and after classification, in ontologies.

Ontology	ELK	jCEL	Snorocket	Pellet	HermiT	FaCT++
GO	23.5	57.4	40.3	231.4	91.7	367.89
SNOMED	31.8	126.6	52.34	620.46	1273.7	1350.5
SNOMEDx2	77.3	OOM[a]	OOM[a]	OOM[a]	OOM[a]	OOM[a]
SNOMEDx3	OOM[a]	OOM[a]	OOM[a]	OOM[a]	OOM[a]	OOM[a]
SNOMEDx5	OOM[a]	OOM[a]	OOM[a]	OOM[a]	OOM[a]	OOM[a]
Traffic	OOM[b]	OOM[c]	OOM[c]	OOM[b]	OOM[b]	OOM[c]

Table 3: Classification times in seconds. OOM[a]: reasoner runs out of memory. OOM[b]: reasoner runs out of memory during incremental classification. OOM[c]: ontology too big for OWL API to load in memory.

Distributed memory reasoning

Ontology	8 nodes	16 nodes	24 nodes	32 nodes	64 nodes
GO	134.49	114.66	109.46	156.04	137.31
SNOMED	544.38	435.79	407.38	386.00	444.19
SNOMEDx2	954.17	750.81	717.41	673.08	799.07
SNOMEDx3	1362.88	1007.16	960.46	928.41	1051.80
SNOMEDx5	2182.16	1537.63	1489.34	1445.30	1799.13
Traffic	60004.54	41729.54	39719.84	38696.48	34200.17

Table 4: Classification time (in seconds) of `DistEL`

Linked Data compression

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- **Using frequent pattern mining to detect rule dependencies in linked datasets. We used this for logically compressing datasets, i.e. replace triples by rules, such that triples can be reconstructed using reasoning. [ESWC 2013]**

Dataset	triples (K)	predicate	transaction (K)	compression ratio	
				intra-property	inter-property
Dog Food	130	132	12	0.98	0.82
CN 2012	137	26	14	0.82	0.43
ArchiveHub	431	141	51	0.92	0.71
Jamendo	1047	25	336	0.99	0.82
LinkedMdb	6147	222	694	0.97	0.75
rdftypes	9237	1	9237	0.19	0.19
RDF About	17188	108	3132	0.97	0.84
DBLP	46597	27	2840	0.96	0.86
Geonames	119416	26	7711	0.97	0.71

Table 1. Compression ratio (based on triple counts) for various linked open datasets. Number of triples and transactions are shown in multiples of 1000.

Rules and Ontologies

- **When modeling logical axioms, we often start by expressing them as rules, and then check if (or how) they can be converted into OWL.**
  [WWW2011, RW2011]

class inclusion/subsumption

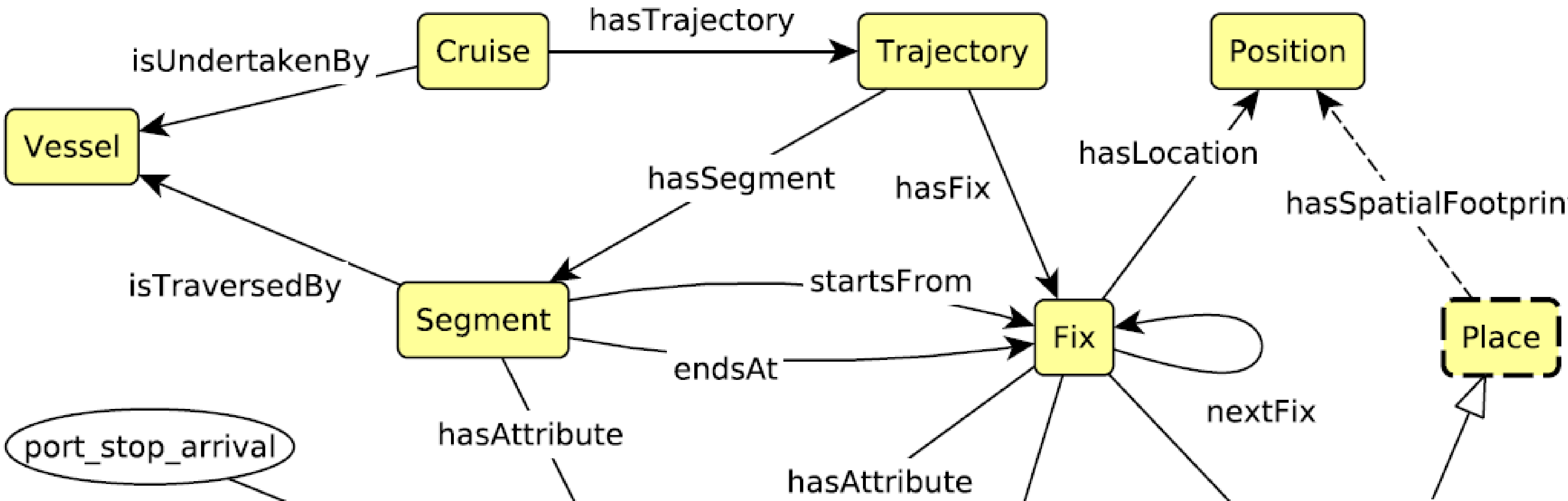
$C \sqsubseteq D \qquad C(x) \rightarrow D(x)$

$C \equiv D \qquad C(x) \leftrightarrow D(x)$

role chains

$R_1 \circ \ldots \circ R_n \sqsubseteq R \qquad R_1(x,x_1) \wedge \ldots \wedge R(x_n,x_{n+1}) \rightarrow R(x,x_{n+1})$

Cruise Trajectories



$$
\begin{aligned}
\mathrm{Cruise}(x) &\wedge \mathrm{hasTrajectory}(x,y) \\
&\wedge \mathrm{hasSegment}(y,z) \wedge \mathrm{isTraversedBy}(z,v) \\
&\rightarrow \mathrm{isUndertakenBy}(x,v)
\end{aligned}
$$

Cruise trajectory

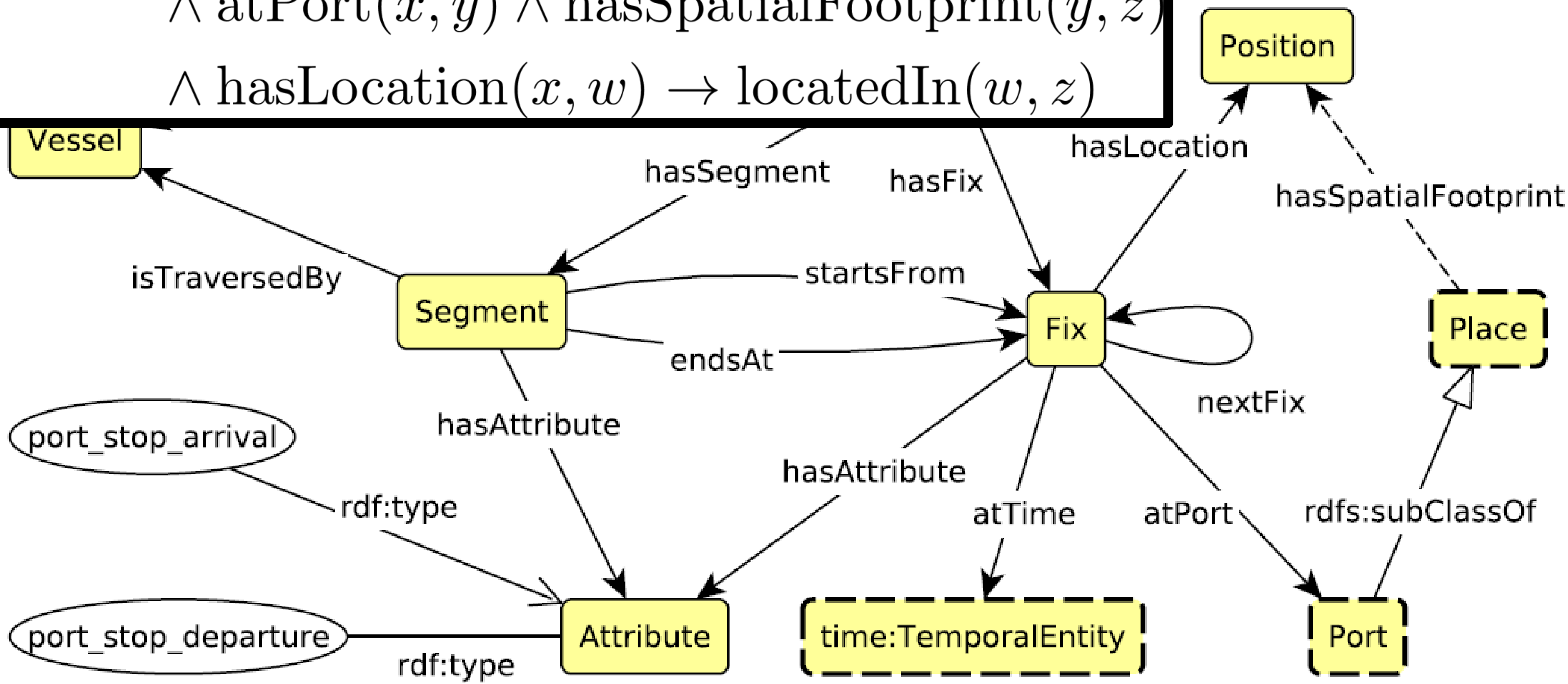
$$\mathrm{Cruise}(x) \wedge \mathrm{hasTrajectory}(x,y) \\ \wedge \mathrm{hasSegment}(y,z) \wedge \mathrm{isTraversedBy}(z,v) \\ \rightarrow \mathrm{isUndertakenBy}(x,v)$$

$$\mathrm{Cruise} \equiv \exists \mathrm{cruise}.\mathrm{Self}$$

$$\mathrm{cruise} \circ \mathrm{hasTrajectory} \circ \mathrm{hasSegment} \circ \mathrm{isTraversedBy} \\ \sqsubseteq \mathrm{isUndertakenBy}$$

Cruise Trajectories

$$
\begin{aligned}
\mathrm{Fix}(x) &\wedge \mathrm{hasAttribute}(x, \mathrm{portStopArrival}) \\
&\wedge \mathrm{atPort}(x, y) \wedge \mathrm{hasSpatialFootprint}(y, z) \\
&\wedge \mathrm{hasLocation}(x, w) \rightarrow \mathrm{locatedIn}(w, z)
\end{aligned}
$$



Cruise trajectory

$$\mathrm{Fix}(x) \wedge \mathrm{hasAttribute}(x, \mathrm{portStopArrival}) \wedge \mathrm{atPort}(x, y) \wedge \mathrm{hasSpatialFootprint}(y, z) \wedge \mathrm{hasLocation}(x, w) \rightarrow \mathrm{locatedIn}(w, z)$$

$$\mathrm{Fix} \sqcap \exists \mathrm{hasTrajectory}.\{\mathrm{portStopArrival}\} \equiv \exists \mathrm{fixps}.\mathrm{Self}$$

$$\mathrm{hasLocation}^{-} \circ \mathrm{fixps} \circ \mathrm{atPort} \circ \mathrm{hasSpatialFootprint} \sqsubseteq \mathrm{locatedIn}$$

Thanks!

http://dase.cs.wright.edu/

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