

On the Diversity and Availability of Temporal Information in Linked Open Data

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Web of Data is dynamic

How much up-to-date are linked open data?



SIG.MA
SEMANTIC INFORMATION MASHUP

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Antonio Cassano

born 12 July 1982) is an Italian professional footballer who plays for Serie A club FC Internazionale Milano (the "jewel of Old Bari"), he is known for his short temper and the coining of the neologism Cassanata by his former coach, Fabio Capello. The word is regularly used by Italian journalists as a euphemism for any behavior incompatible with the club's interests. He was raised in Bari and his father left the family shortly thereafter. He began playing football at an early age. Cassano was spotted by an A.S. Bari scout in 2000. He signed for the club in 2001. His first season was successful, as he scored 10 goals in 28 appearances. He attracted attention after he was left out of a practice match a few days before his international debut.

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Summer 2012 →

MILANO - C [20]

currentclub: [Associazione Calcio Milan S.p.A.](#) [2]

club: http://dbpedia.org/resource/AS_Roma [2]
[Unione Calcio Sampdoria_SpA](#) [2]
http://dbpedia.org/resource/Sampdoria_Genua [2]
[Real Madrid](#) [2]
http://dbpedia.org/resource/AC_Milan [2]
[AS Bari](#) [2]

Sources (20) Approved (0) Rejected (0)

- 1 [Antonio Cassano](#) 12 facts | 2012-11-03
<http://rdf.basekb.com/ns/m.036wt/>
- 2 [Antonio Cassano](#) 345 facts | 2012-06-05
http://dbpedia.org/resource/Antonio_Cassano
- 11 [Pictures of Antonio Cassano](#) 20 facts | 2012-06-21
<http://ookaboo.com/o/pictures/topic/25057...>
- 12 [Untitled document](#) 1 facts | 2012-07-13
<http://www.voetbal.be/nieuws-tags/antonio...>
- 13 [Antonio Cassano | Canal+](#) 18 facts | 2012-05-09
<http://www.canalejuve.it/tags/antonio-cas...>

<- 1 2 -> [↑ reject all](#) [↑ approve all](#)

November, 2nd 2012

Temporal information, applications and research problems

Collecting and processing temporal information is crucial for several applications and research problems

- Temporal Query Answering and Search [Alonso&2011]
- Temporal Validity of Statements [Wang&2010]
- Data Fusion and Integration [Mendes&2012]
- Temporal Data Exploration [Alonso&2011]
- Temporal Entity Matching [Li&2011]
- Currency of Statements and Documents [Rula&2012]
- Analysis of provenance of information [Hartig&2009]

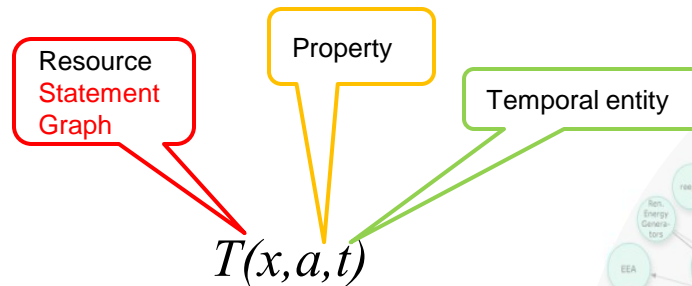
Contribution of Our Research

- Temporal Information in the LOD cloud
 - General analysis of temporal information (BTC dataset)
 - Temporal meta-information
- Temporal Meta-information Analysis
 - Systematic review of proposed models
 - Quantitative analysis based on large-scale experiment (BTC dataset)
- Conclusion
 - Guidelines for consumers and publishers

Temporal Information vs Temporal meta-information (Abstract Definition)

Temporal information

a ternary relation $T(x,a,t)$, where x is a resource, a is a statement, or a graph, t is a temporal entity

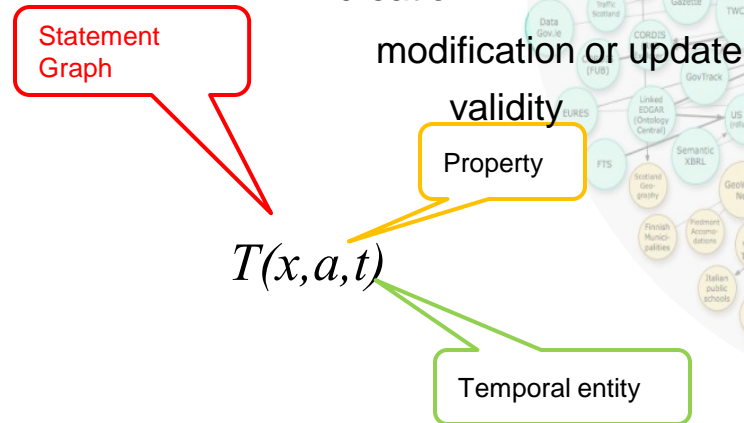


$T(:Rihanna,foaf:dateOfBirth,1980-09-04)$

$T(foafRihanna.rdf,dc:modified,2012-09-10)$

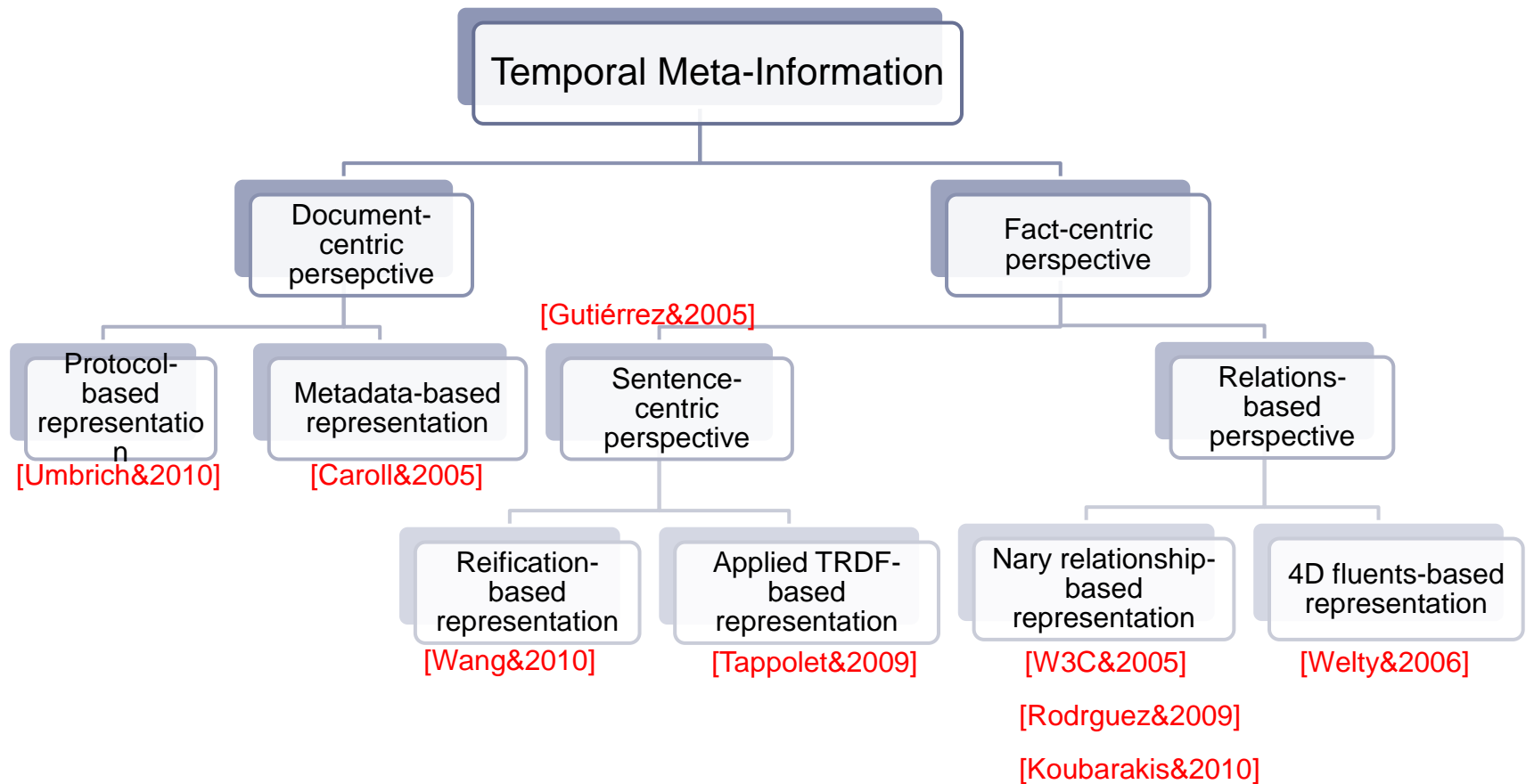
Temporal meta-information (TMI)

a piece of temporal information $T(x,a,t)$ is interpreted as temporal meta-information if and only if x is interpreted as a truth-valued RDF element (statement or graph)



$T(foafRihanna.rdf,dc:modified,2012-09-10)$

Models for representing TMI



Availability of TMI

Perspective	Approach	Occurrence temp. quads (%)	Occurrence overall quads (%)	Occurrence overall docs (%)
Document	Protocol	n/a	n/a	9.500
	Metadata	5.10	0.0001900	0.560
Fact	Reification	0.02	0.0000008	0.006
	Applied temporal RDF	-	-	-
	N-ary relationship	12.24	0.0005000	0.600
	4D fluents	-	-	-

- Low availability (in the BTC)
- High diversity (models and vocabularies)
- Automatic interpretation/processing is not trivial (e.g., metadata-based and N-ary relationship)

Guidelines (I)



Perspective	Approach	Consumers	Publishers
Document	Protocol	<ul style="list-style-type: none">- retrieve TMI in the Protocol-based rep	<ul style="list-style-type: none">- provide Last-modified field in the HTTP header- update TMI whenever the data in the document is changed
	Metadata	<p><i>otherwise</i></p> <ul style="list-style-type: none">- retrieve TMI from the Metadata-based rep.	<ul style="list-style-type: none">- check for TMI to be consistent in both Protocol- and Metadata-based rep.

Guidelines (II)



Perspective	Approach	Consumers	Publishers
Fact	Reification	<ul style="list-style-type: none">- retrieve TMI by using the predicates in the RDF reification vocabulary	<ul style="list-style-type: none">- evaluate based on the application scenario if it is possible to avoid such rep.- avoid its use since it is cumbersome with SPARQL queries
	Applied temporal RDF		<ul style="list-style-type: none">- use the Applied temporal RDF rep. rather than pure Reification-based repr.- avoid the worst case when using the applied temporal RDF
	N-ary relationship	<ul style="list-style-type: none">- difficult to be identified	<ul style="list-style-type: none">- use N-ary relationship-based rep. for complex modelling tasks because of its flexibility