



How the Semantic Web is transforming information access

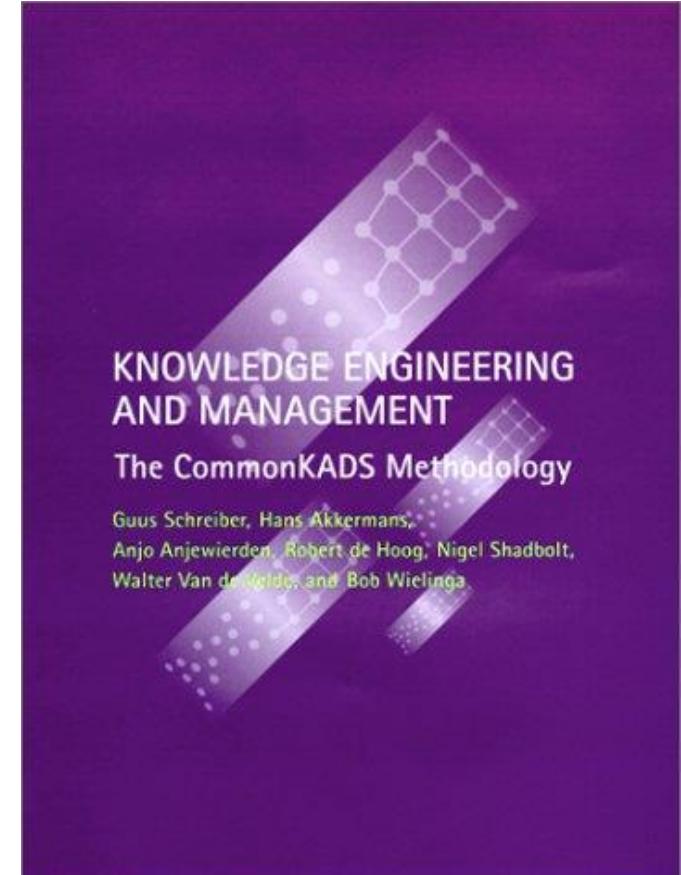
Guus Schreiber
VU University Amsterdam

Overview of this talk

- My journey
- Knowledge engineering in the Web era
- Using knowledge for enriched information access
- Selection of (research) issues

My journey knowledge engineering

- design patterns for problem solving
- methodology for knowledge systems
- models of domain knowledge
- ontology engineering



My journey access to digital heritage

E-Culture MultimediaN *cultural heritage search*

search | browse | local view | annotate | search | [Login](#) | [help](#) | [English](#)

This cultural search engine will give you access to artworks from several museum collections. Type a keyword, for example: Derain, calligraphy, or 1867.

search | **SEARCH**

Collections

				
Artchive.com (>3,000 objects)	Rijksmuseum.nl (>16,000 objects)	RMV.nl (>10,000 objects)	KIT.nl (>78,000 objects)	Bibliopolis.nl (>1,600 objects)

Vocabularies and thesauri

				
Getty AAT (>31.000)	Getty ULAN Person (>130.000)	Getty TGN Place (>890.000)	SVCN (Dutch ethnology, >11.000)	Princeton Wordnet (>115.000)

My journey Web standards



Chair of

- Web metadata: RDF 1.1
- OWL Web Ontology Language 1.0
- SKOS model for publishing vocabularies on the Web
- Deployment & best practices



A few words about Web standardization



- Key success factor!
- Consensus process actually works
 - Some of the time at least
- Public review
 - Taking every comment seriously
- The danger of over-designing
 - Principle of minimal commitment



KNOWLEDGE ENGINEERING IN THE WEB ERA

Key principle: Think large!



Doug Lenat (IJCAI Milan 1987:
“On the thresholds of knowledge”)

“Once you have a truly massive amount of information integrated as knowledge, then the human-software system will be superhuman, in the same sense that mankind with writing is superhuman compared to mankind before writing.”

Google Knowledge Graph: 70 billion facts (October 2016)



RF-IDentification

luc steels

Todo Noticias Imágenes Maps Vídeos Más Configuración Herramientas

Aproximadamente 56.500 resultados (0,39 segundos)

Sugerencia: [Buscar solo resultados en español](#). Puedes especificar tu idioma de búsqueda en [Preferencias](#)

Luc Steels | VUB Artificial Intelligence Lab
<https://ai.vub.ac.be/members/steels> ▾ [Traducir esta página](#)
Luc Steels studied linguistics at the University of Antwerp (Belgium) and computer science at the Massachusetts Institute of Technology (USA). His main ...

Luc Steels - Wikipedia
https://en.wikipedia.org/wiki/Luc_Steels ▾ [Traducir esta página](#)
Luc Steels (born 1952) is a Belgian scientist and artist, and Director of the Artificial Intelligence Laboratory of the Vrije Universiteit Brussel. He also founded the ...

Luc Steels - Citas de Google Académico

**Luc
Steels**

Científico

Share icon

Fecha de nacimiento: 22 de enero de 1952 (edad 65), Bélgica

Educación: Universidad de Amberes

Libros: The Talking Heads experiment: Origins of words and meanings



WordNet(s): semantic networks of language terms



Noun

- **S: (n) chair** (a seat for one person, with a support for the back) "*he put his coat over the back of the chair and sat down*"
- **S: (n) professorship, chair** (the position of professor) "*he was awarded an endowed chair in economics*"
 - *direct hypernym* / *inherited hypernym* / *sister term*
 - *derivationally related form*
- **S: (n) president, chairman, chairwoman, chair, chairperson** (the officer who presides at the meetings of an organization) "*address your remarks to the chairperson*"
- **S: (n) electric chair, chair, death chair, hot seat** (an instrument of execution by electrocution; resembles an ordinary seat for one person) "*the murderer was sentenced to die in the chair*"
- **S: (n) chair** (a particular seat in an orchestra) "*he is second chair violin*"

Verb

- **S: (v) chair, chairman** (act or preside as chair, as of an academic department in a university) "*She chaired the department for many years*"
- **S: (v) moderate, chair, lead** (preside over) "*John moderated the discussion*"

http://www.getty.edu/vow/ULANFullDisplay?find=matisse&role=&nation=&prev_page=1&subjectid=5000173

Research

Research Home ▶ Conducting Research ▶ Union List of Artist Names ▶ Full Record Display

Union List of Artist Names® Online

Full Record Display

[New Search](#) [◀ Previous Page](#)

Click the  icon to view the artist's biography.

ID: 500017300

 **Matisse, Henri** (French)

Names

Matisse, Henri	artist (preferred)
Matisse, Henri	painter
Matisse, Henri	printmaker
Matisse, Henri	sculptor
Matisse, Henri	designer
Matisse, Henri	writer

Nationality

French

Roles:

artist
painter
printmaker
sculptor
designer
writer

Gender: male

Birth and Death Places:

Born: [Le Cateau-Cambrésis \(Nord, Nord-Pas-de-Calais, France\) \(inhabited place\)](#)

Died: [Nice \(Alpes-Maritimes, Provence-Alpes-Côte d'Azur, France\) \(inhabited place\)](#)

Iconclass: categorizing image scene



Image 1 Themes

ICONCLASS Subject Classification

Search using: "baring the head, lifting one's hat" (it has 101 hits)

[Show Kw](#) | [SPACES](#) | [Hide Codes](#) | [de](#) | [fr](#) | [it](#) | [fi](#) | [Top](#) |

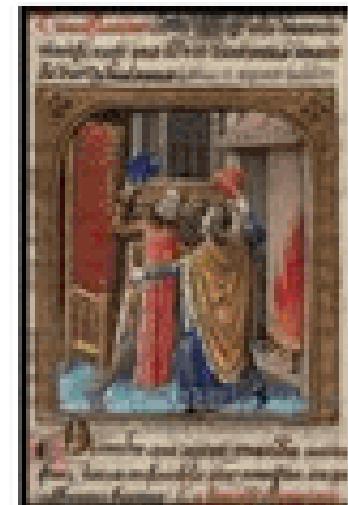
3 Human Being, Man in General

33 relations between individual persons

33A non-aggressive relationships

33A1 saluting

33A11 baring the head, lifting one's hat



Other frequently-used ontologies

- Dublin Core
- Friend-of-a-Friend
- Schema.org
- Library of Congress Subject Headings
-

Lessons for knowledge engineering

1. Be modest
 - appreciate what is already available
2. Don't recreate, but enrich and align
3. Ontologies represent consensus
 - “creating my own ontology” is a *contradictio in terminis*
4. Beware of ontological over-commitment

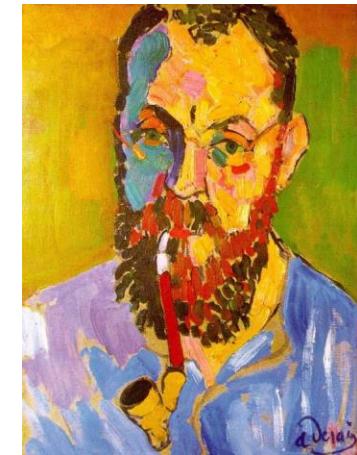
The Web: resources and links



URL



Web link



URL

The Semantic Web: typed resources and links

Painting
“Woman with hat”
SFMOMA

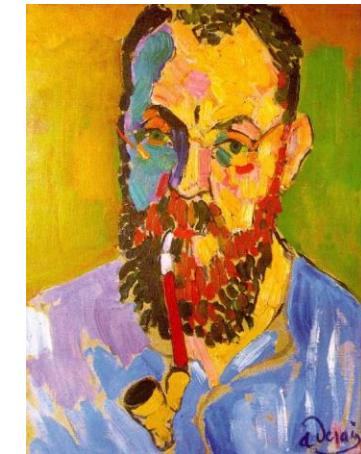


URL

Dublin Core
creator

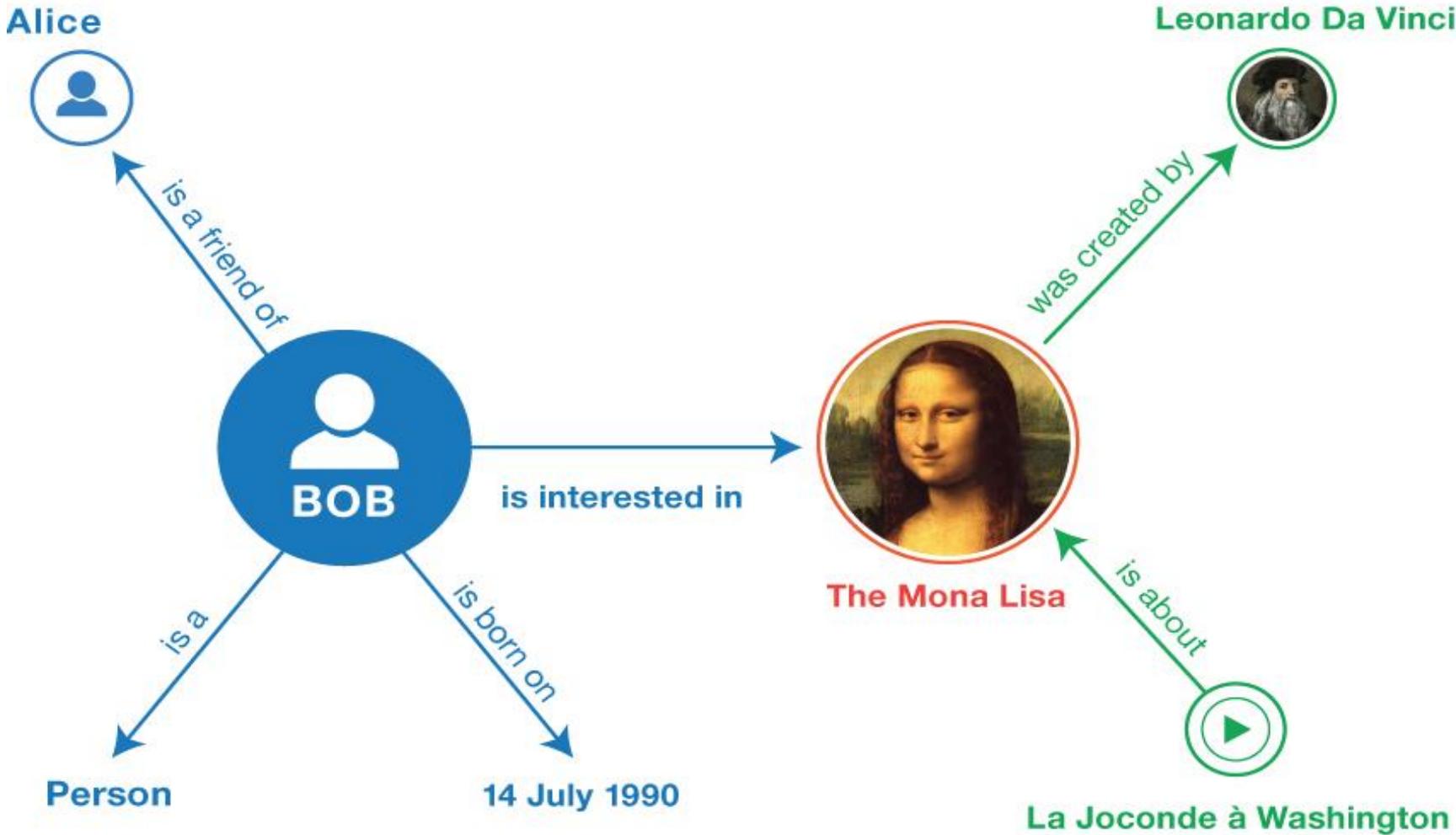
ULAN
Henri Matisse

Web link



URL

Knowledge representation: graphs



Generating Linked Data



USING KNOWLEDGE FOR INFORMATION ACCESS

Strategies for using knowledge in information retrieval

- Enrich corpus used for information retrieval
 - E.g. add synonyms
- Enriched presentation of search results
- Custom-tailored search algorithms
 - Graph search
 - Recommendation

Enriching metadata with concepts

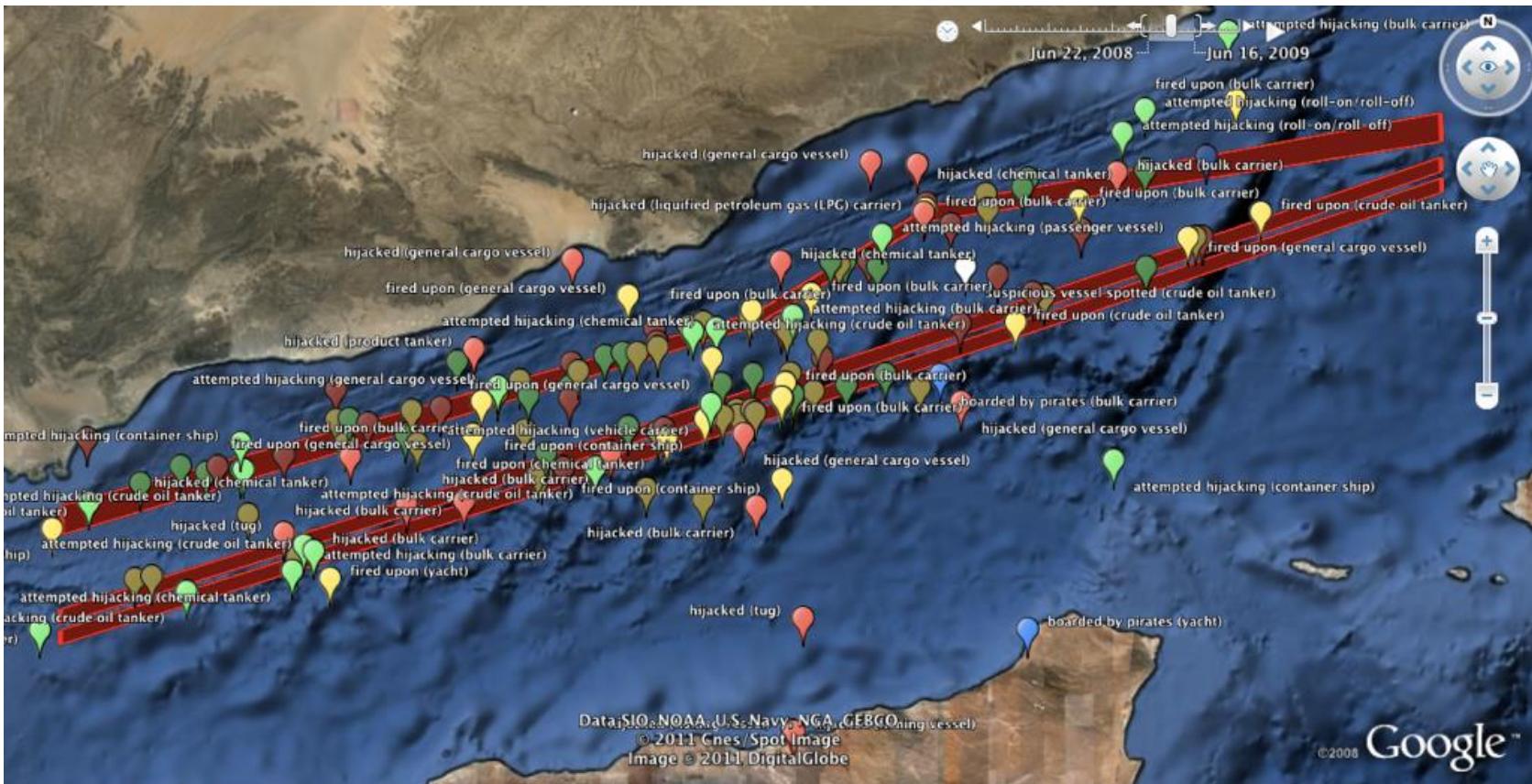
Woman with a Fan

<http://t-d-b.org?http://www.artchive.com/artchive/p/picasso/womanfan.jpg>



Property	Value
<u>Creator</u>	<u>Picasso, Pablo</u>
<u>Location</u>	<u>Paris; The Hermitage Museum, St. Petersburg</u>
<u>Material</u>	<u>canvas; oil paint</u>
<u>Measurements</u>	<u>152 x 101 cm</u>
<u>Title</u>	<u>Woman with a Fan</u>

Visualising piracy events



Sample graph search algorithm

From search term (literal) to art work:

- Find resources with matching label
- Find path from resource to art work
 - Cost of each step (step when above cost threshold)
 - Special treatment of semantics: sameAs, inverseOf, ...
- Cluster results based on path similarities

Graph search: “Picasso”

Firefox File Edit View History Bookmarks Tools Window Help

search: picasso

http://e-culture.multimedian.nl/demo/search?query=picasso

▼ Works in museum (2)

 Self-Portrait
Miró, Joán

 Portrait of a Spanish
Miró, Joán

▼ Works created by (92)

 Rembrandtesque
Picasso, Pablo

 Reservoir at Horta
Picasso, Pablo

 Still Life with
Picasso, Pablo

 Glass, Dice, and
Picasso, Pablo

 Seated Old Man
Picasso, Pablo

► Works with style/period Surrealist also used by artist (1)

► Works with style/period Cubist also used by artist (1)

▼ Works by professionally related artist (31)

 Fruit Dish, Ace of Clubs
Braque, Georges

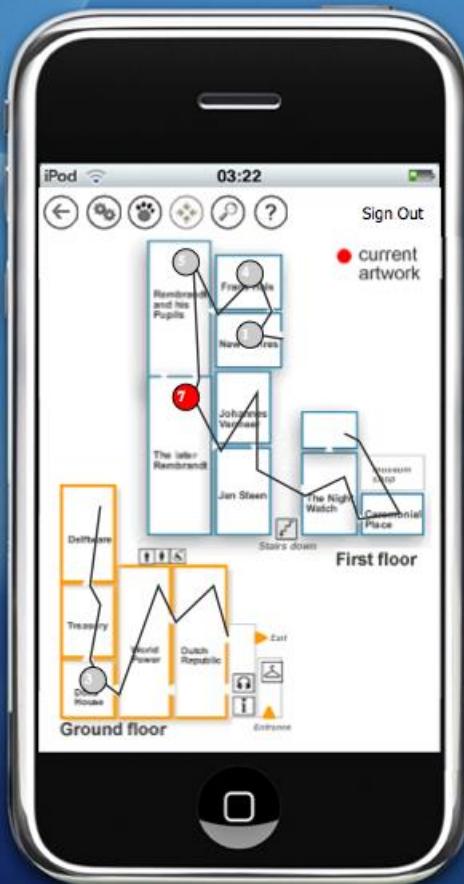
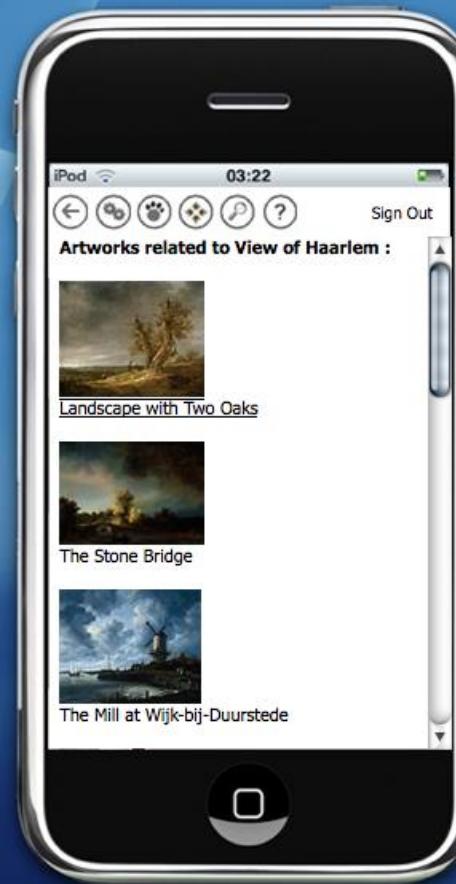
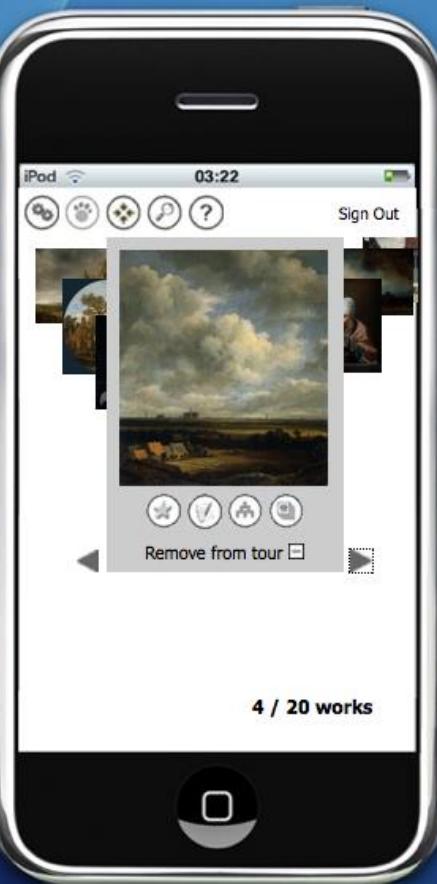
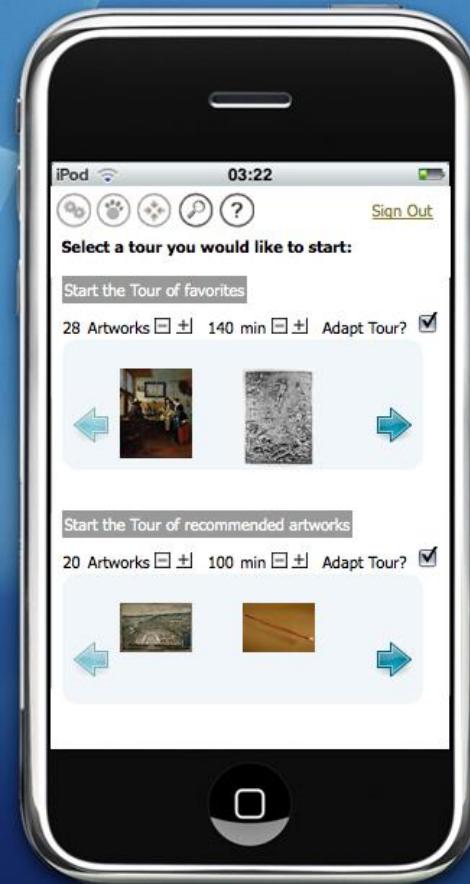
 Man with a Violin
Braque, Georges

 Bottle, Newspaper,
Braque, Georges

 Still Life BACH
Braque, Georges

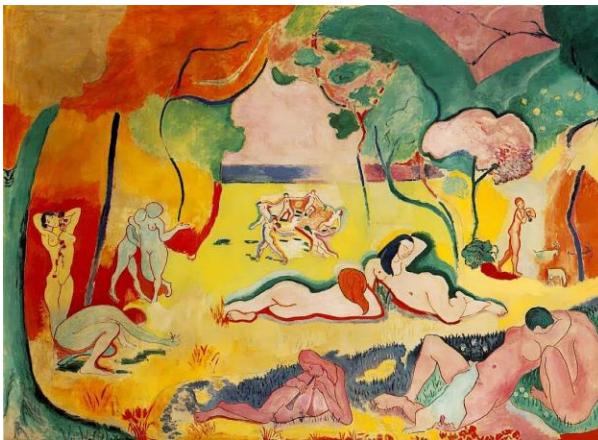
 Black Fish
Braque, Georges

Generating a personalized museum tour

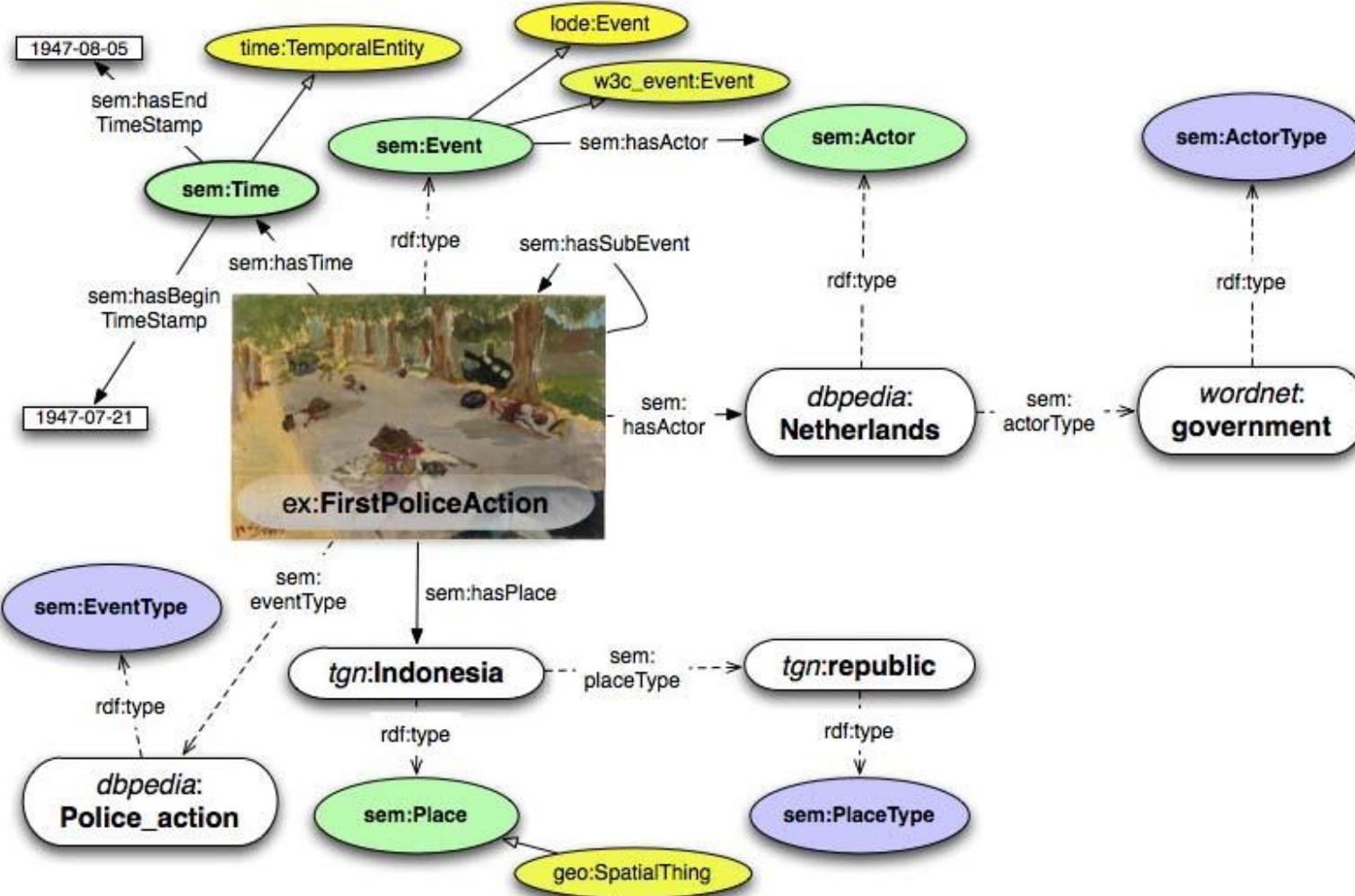


Challenge: relation search

Picasso, Matisse & Braque



Challenge: event-centered approach => people like narratives



RESEARCH ISSUES IN KNOWLEDGE ENGINEERING

The myth of a unified ontology

- In large virtual collections there are always multiple ontologies
 - In multiple languages
- Every ontology has its own perspective
 - You can't just merge them
- But: you can use ontologies jointly by defining a limited set of links!
- Large body of research on “ontology alignment”

Limitations of categorical thinking

- The set theory on which ontology languages are built is inadequate for modelling how people think about categories (Lakoff)
 - Category boundaries are not hard: cf. art styles
 - People think of prototypes; see theory of Rosch
- We need to make meta-distinctions in hierarchies explicit
 - organizing class: “furniture”
 - base-level class: “chair”
 - domain-specific: “Windsor chair”

Use of crowdsourcing to annotate data

- Collecting annotation data on text, images, sounds and videos
- Use as gold standard for learning algorithms
 - Inter-observer agreement
 - Are experts better annotators than laypersons?



Man bij hond

Woordentikkertje



Hallo, Michiel! [uitloggen »](#)
0
Uw puntentotaal



Winner EuroTV Competition
Best Archives on the Web Award

Hoe houdt u de stemming erin?

nog 00:15

510

1 / 2

Uw Ingevulde woorden:

glasses	+5
babbelbox	+5



515

1 / 2

Uw Ingevulde tags:

jenever	+5
head	+150
match met head van biktorrr. Jij hebt dit woord geïntroduceerd	
man	+5
woman	+5
beard	+150
match met beard van biktorrr. Jij hebt dit woord geïntroduceerd	
meeting	+5
bar	+25
geografische naam	
wine	+150

Deelnemers

1 Michiel 2 biktorrr

Uw bijdrage in dit spel

punten

8 tags zonder match ?	40
1 geografische naam ?	25
0 persoonsnamen ?	0
3 matches met medespelers ?	150
3 pioniersmatches ?	300

Puntentotaal

515

Kijk hiermaast in het overzicht van 'Uw ingevoerde tags' voor een specifieker toelichting per match.

Meer punten verdienen?

Daag vrienden uit om dit spel te spelen en vergroot uw eigen kans op een hogere score ?



32

Nichesourcing: finding the right minority vote



annotation

“the frog stands for the rejected lover”

quality level



“The frog indicates the profession of the women”



“women”



“Sexy ladies!”



A small selection of issues

- Ownership/rights of knowledge sources
 - Incorporation of public data in private data
- Open access
- Fair use of (lay/expert) crowd
- Explicit knowledge sources support explanation?