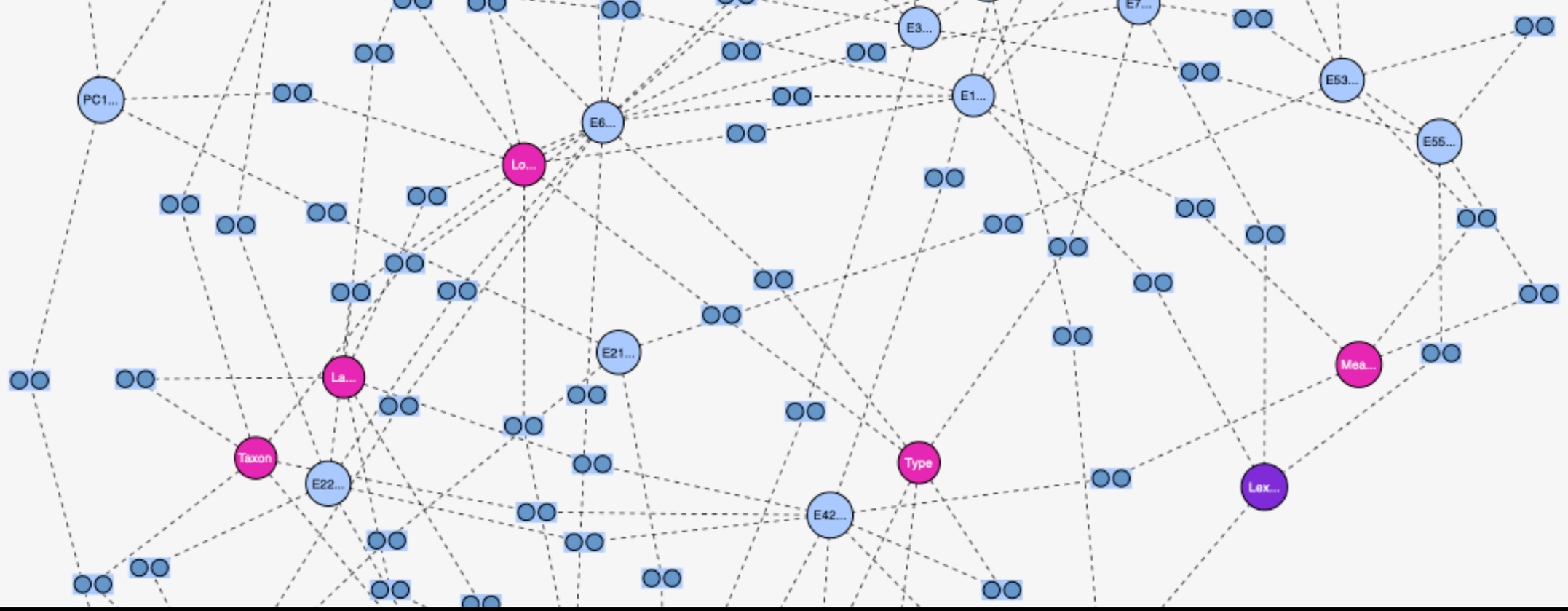


REPRÉSENTATION DES CONNAISSANCES

NICOLA CARBONI

- Logic
- Ontology
- Computation

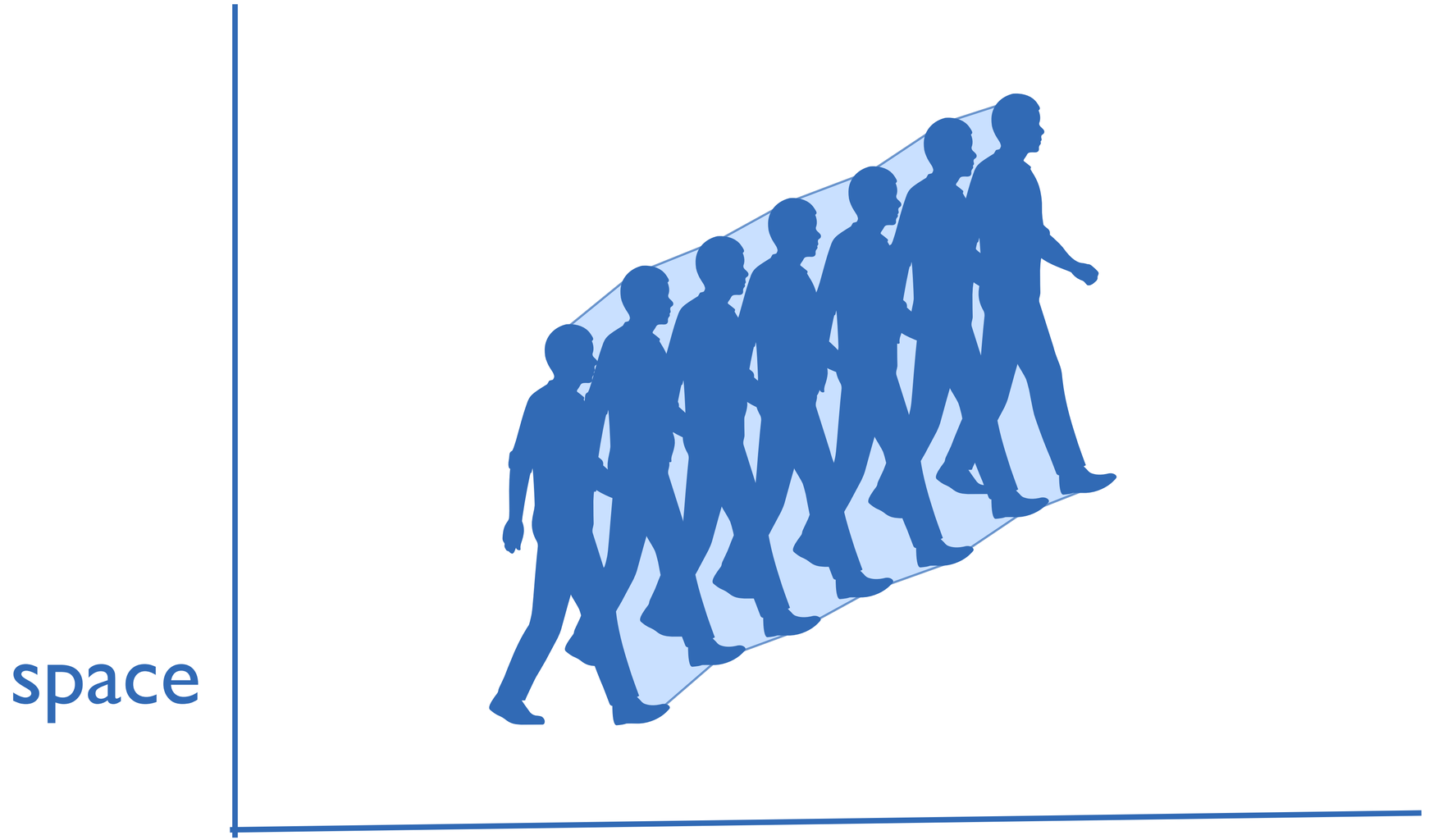
"Knowledge representation is the application of logic and ontology to the task of constructing computable models for some domains." **- J. *Sowa***

concrete and abstract objects

3 + 2 = 5

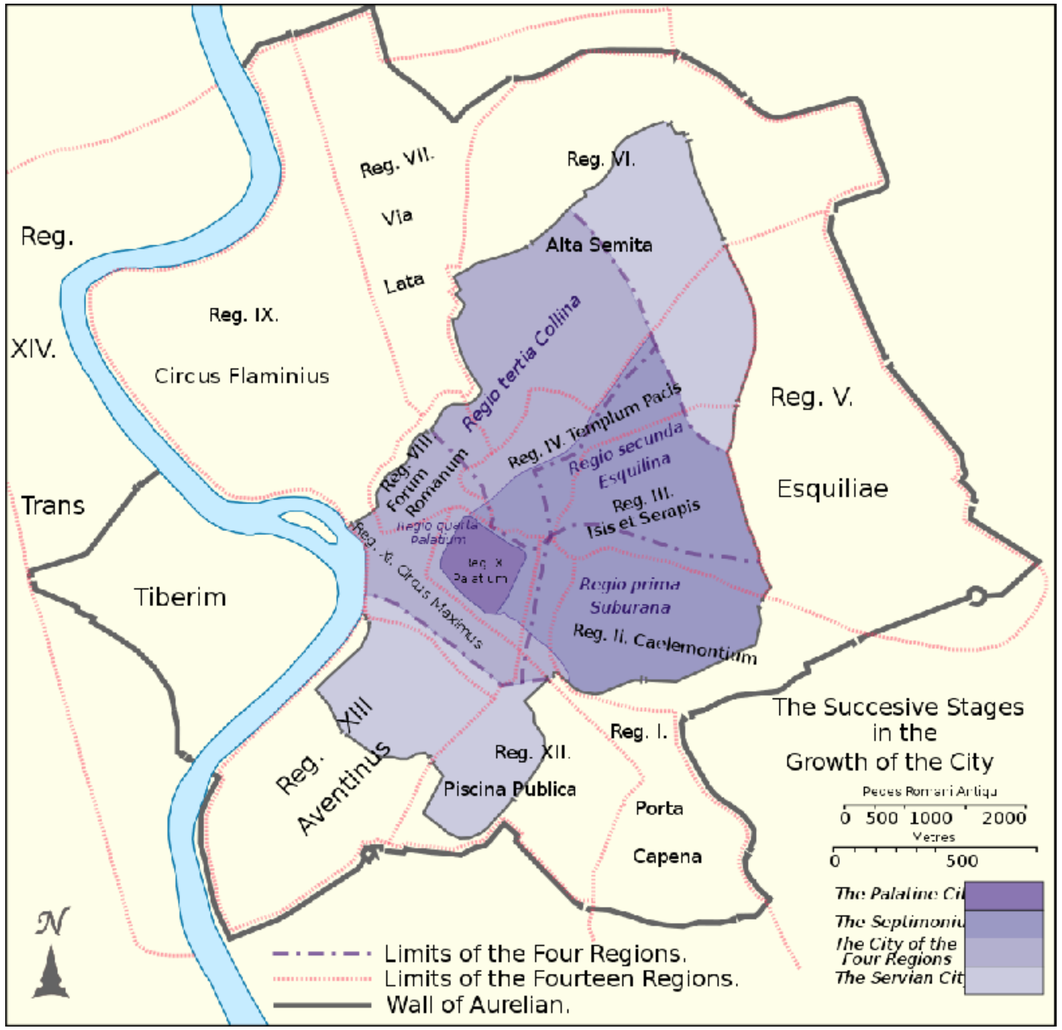
events

events



vagueness

cities


Reg. VII.
Via
Lata
Reg. VI.
Alta Semita
Reg.
XIV.
Reg. IX.
Circus Flaminius
Regio tertia Collina
Reg. V.
Reg. VIII.
Forum Romanum
Reg. IV. Templum Pacis
Regio secunda Esquilina
Esquiliae
Reg. III. Isis et Serapis
Trans
Tiberim
Regio quarta Palatium
Reg. X Palatium
Reg. XI. Circus Maximus
Regio prima Suburana
Reg. II. Caelemontium
The Succesive Stages in the Growth of the City
Reg. I.
Reg. XIII
Reg. Aventinus
Reg. XII.
Piscina Publica
Porta Capena
Pedes Romani Antiqui
0 500 1000 2000
Metres
0 500
The Palatine Ci
The Septimoni
The City of the Four Regions
The Servian Cit
N
Limits of the Four Regions.
Limits of the Fourteen Regions.
Wall of Aurelian.

concrete and abstract objects

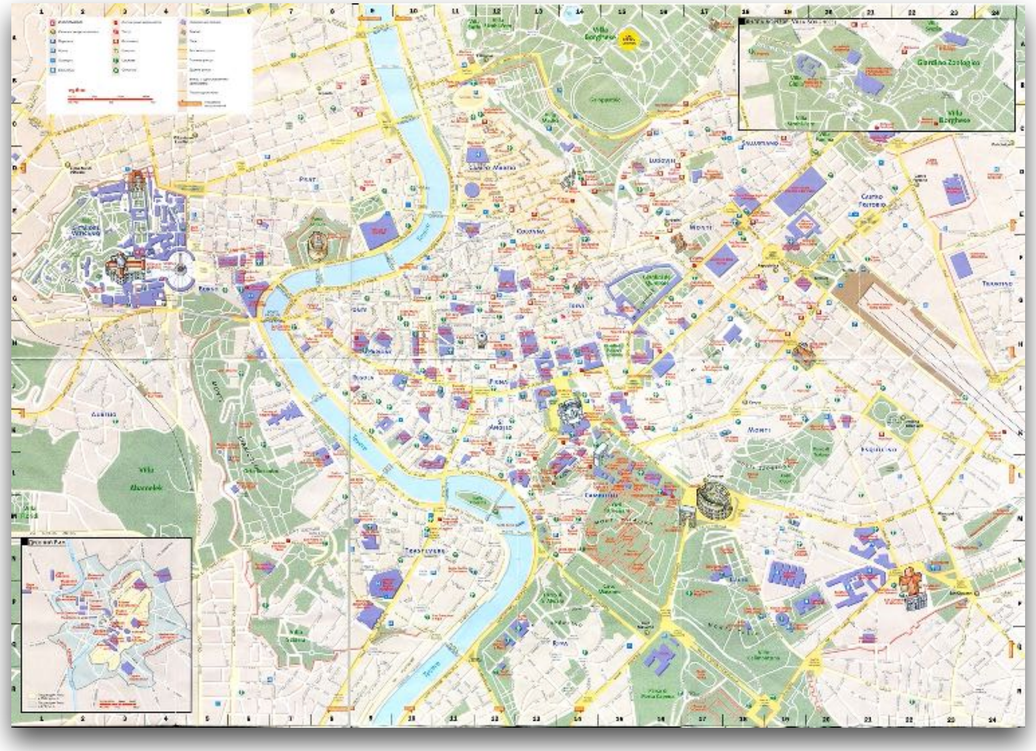
social objects

social objects

social objects

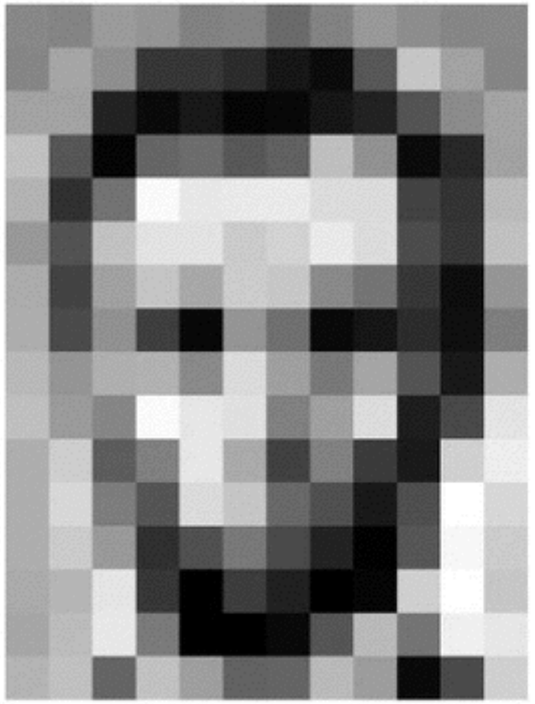
social objects

1750



today

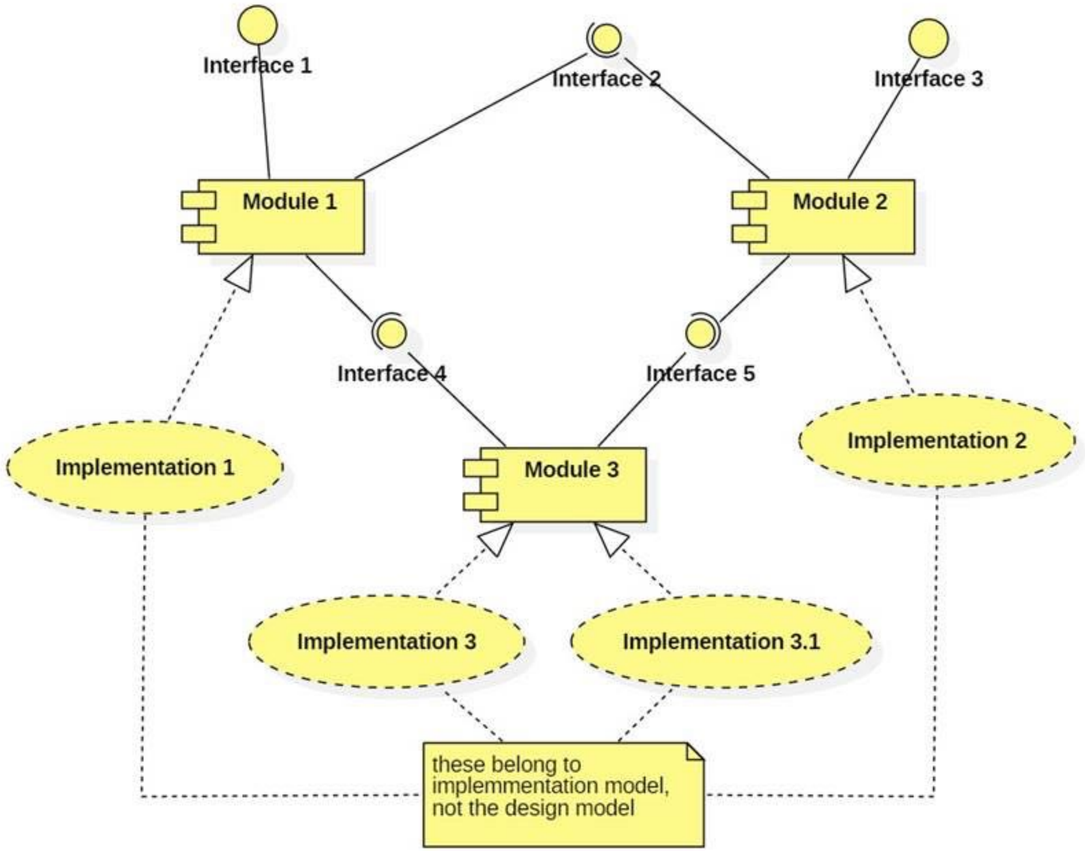
models



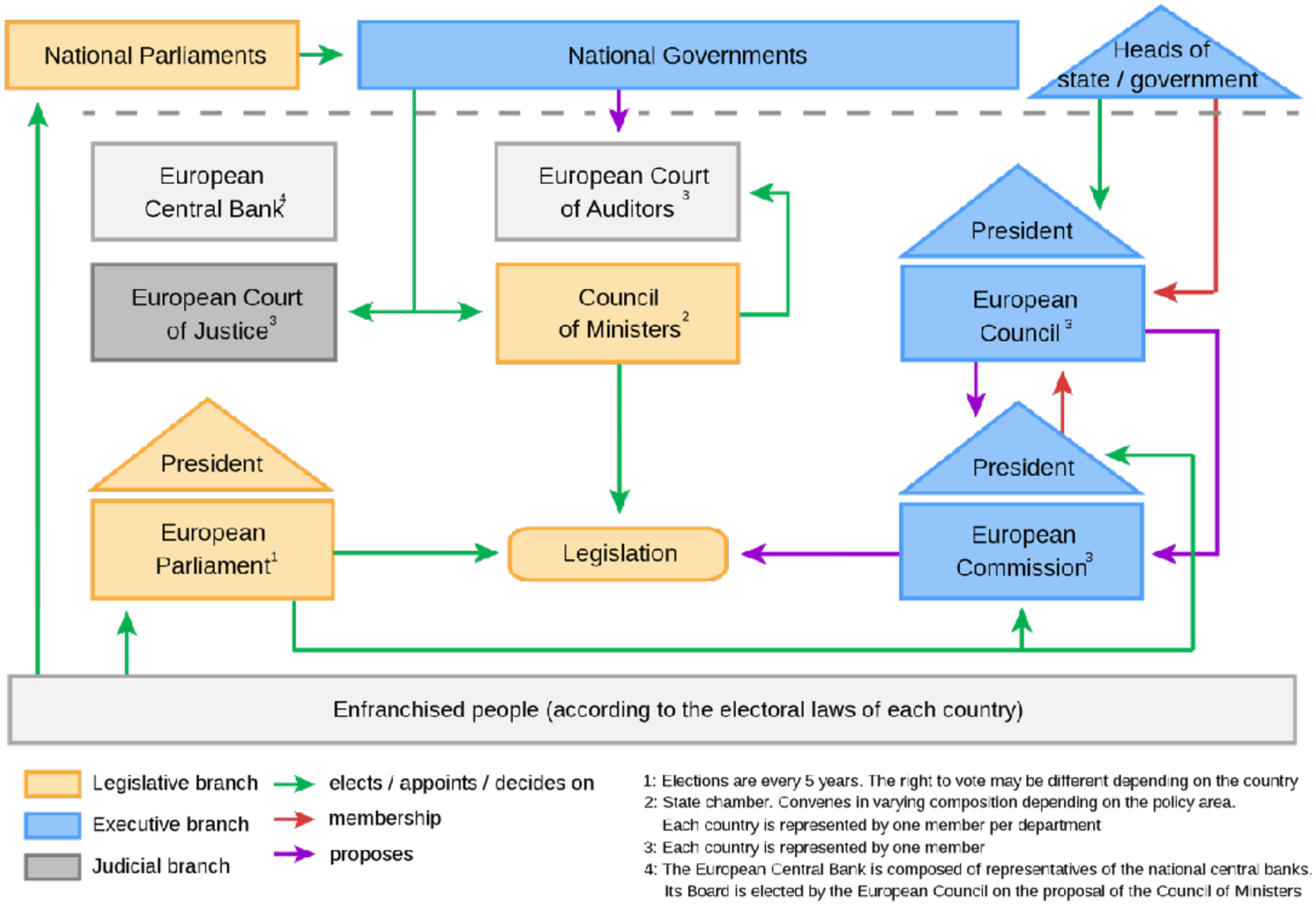
157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	85	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

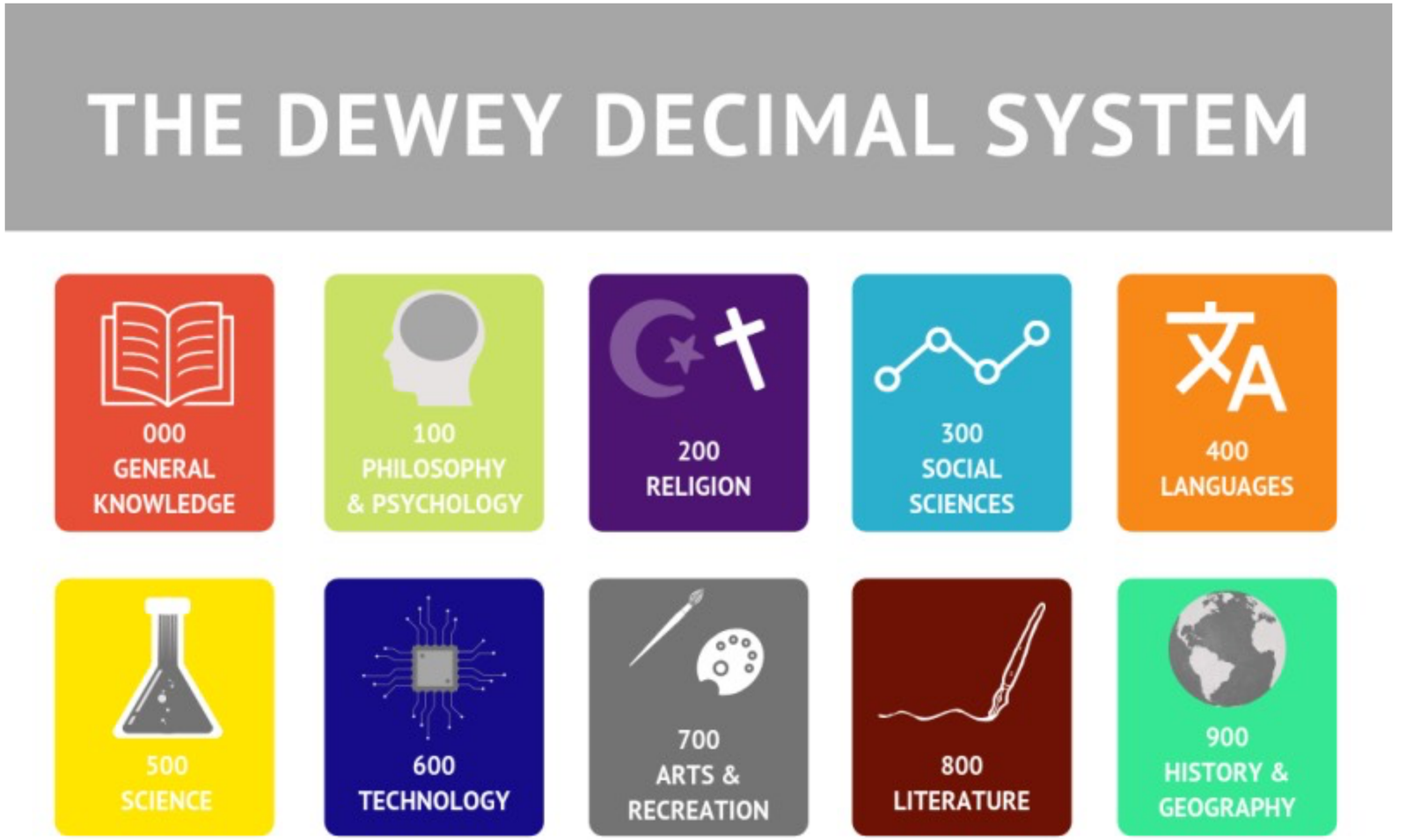
models


Interface 1
Interface 2
Interface 3
Module 1
Module 2
Interface 4
Interface 5
Implementation 1
Module 3
Implementation 2
Implementation 3
Implementation 3.1
these belong to
implemmentation model,
not the design model

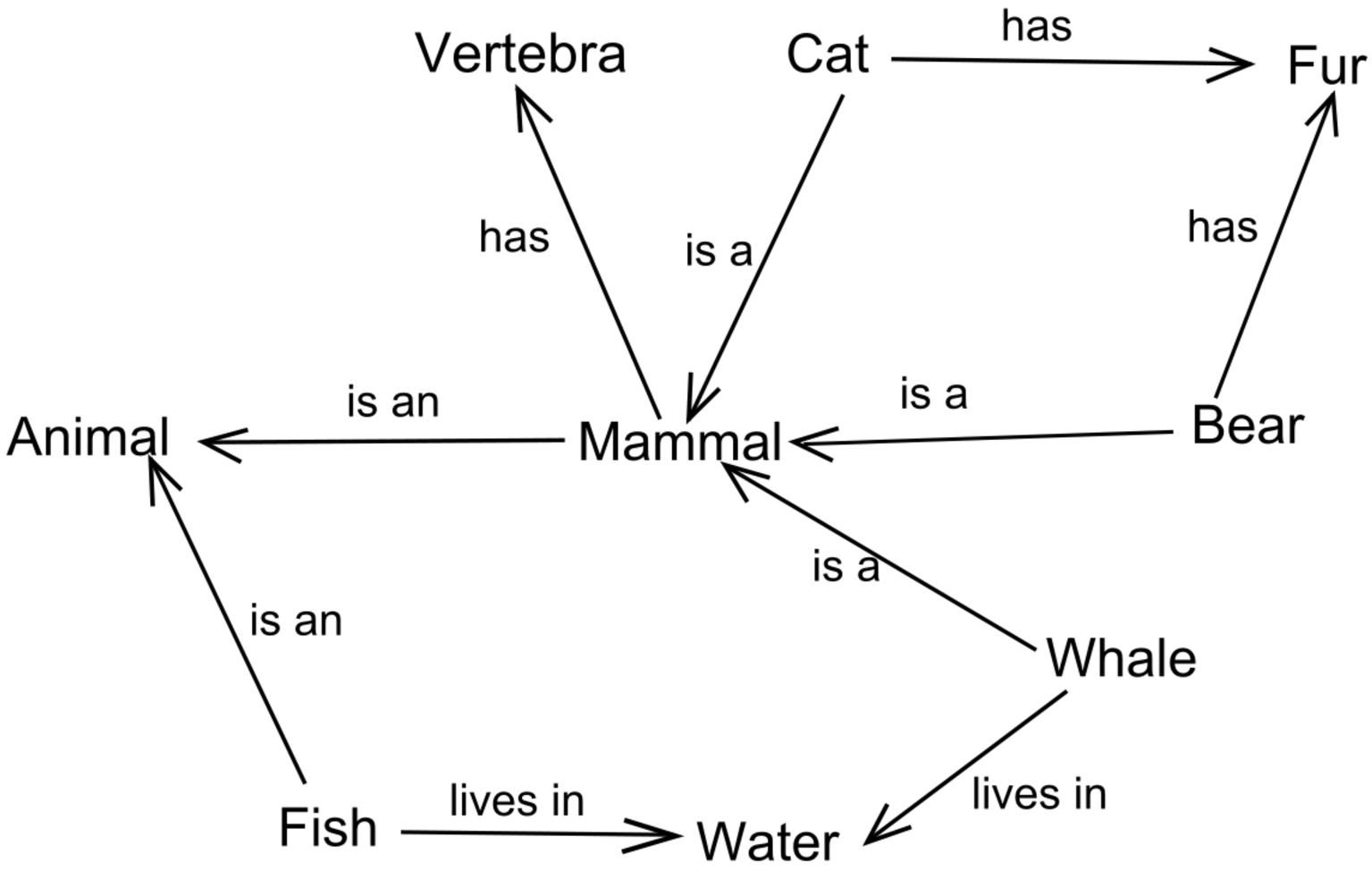
models


National Parliaments
National Governments
Heads of state / government
European Central Bank[4]
European Court of Auditors[3]
President
European Court of Justice[3]
Council of Ministers[2]
European Council[3]
President
European Parliament[1]
Legislation
President
European Commission[3]
Enfranchised people (according to the electoral laws of each country)
Legislative branch
Executive branch
Judicial branch
elects / appoints / decides on
membership
proposes
1: Elections are every 5 years. The right to vote may be different depending on the country
2: State chamber. Convenes in varying composition depending on the policy area.
Each country is represented by one member per department
3: Each country is represented by one member
4: The European Central Bank is composed of representatives of the national central banks.
Its Board is elected by the European Council on the proposal of the Council of Ministers

models


THE DEWEY DECIMAL SYSTEM
000 GENERAL KNOWLEDGE
100 PHILOSOPHY & PSYCHOLOGY
200 RELIGION
300 SOCIAL SCIENCES
400 LANGUAGES
500 SCIENCE
600 TECHNOLOGY
700 ARTS & RECREATION
800 LITERATURE
900 HISTORY & GEOGRAPHY

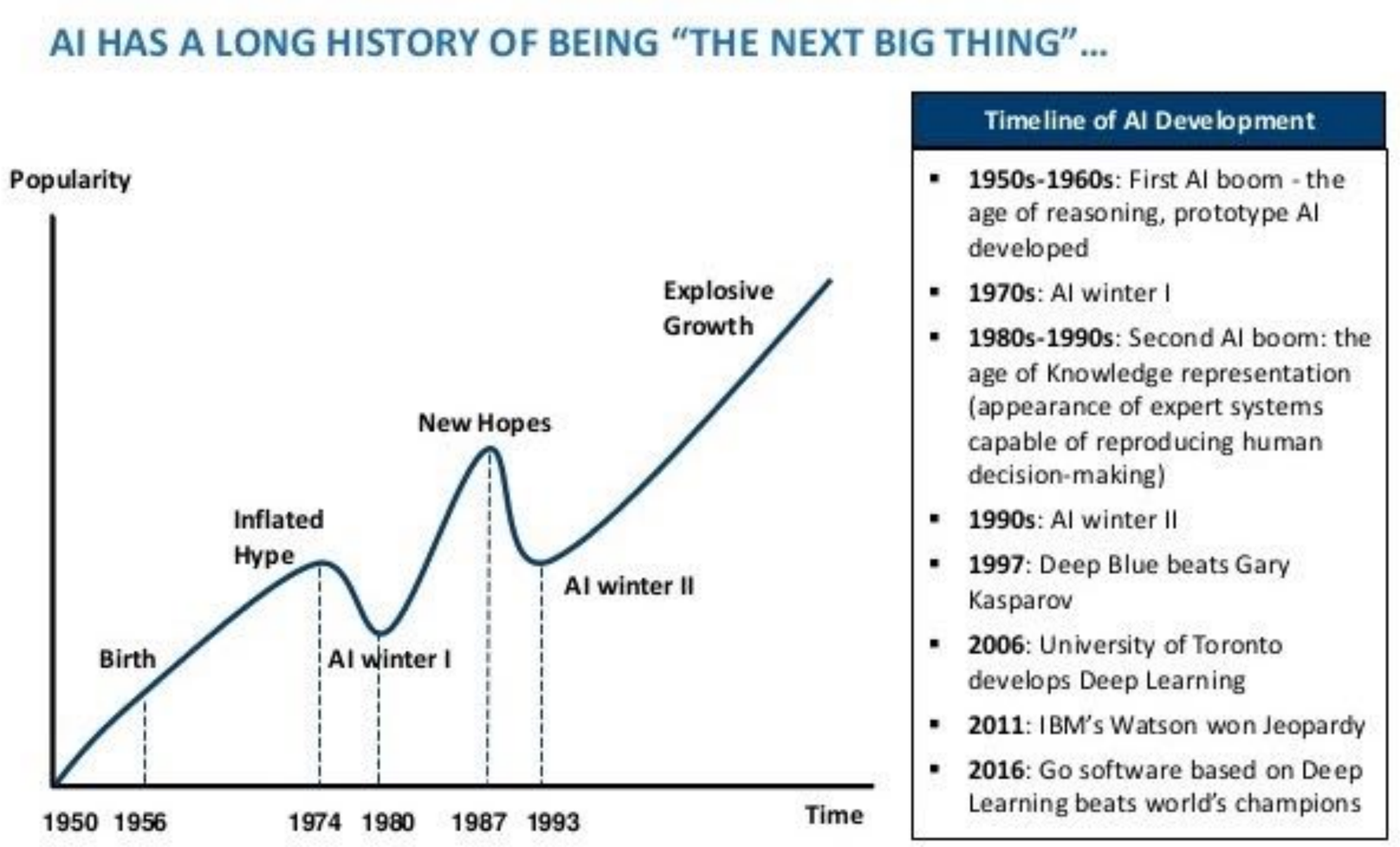
semantic net



frame


Crime_scenario
Committing_crime
Criminal_investigation
Criminal_process
8 children total
Arrest
Arraignment
Trial
Sentencing
Notification_of_charges
Entering_of_plea
Bail_setting

winter

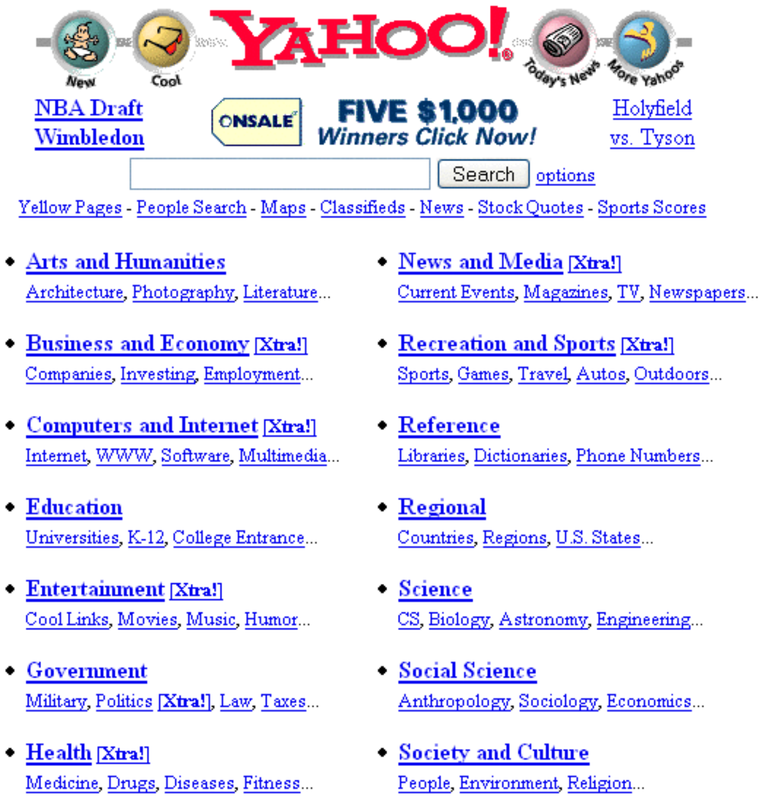


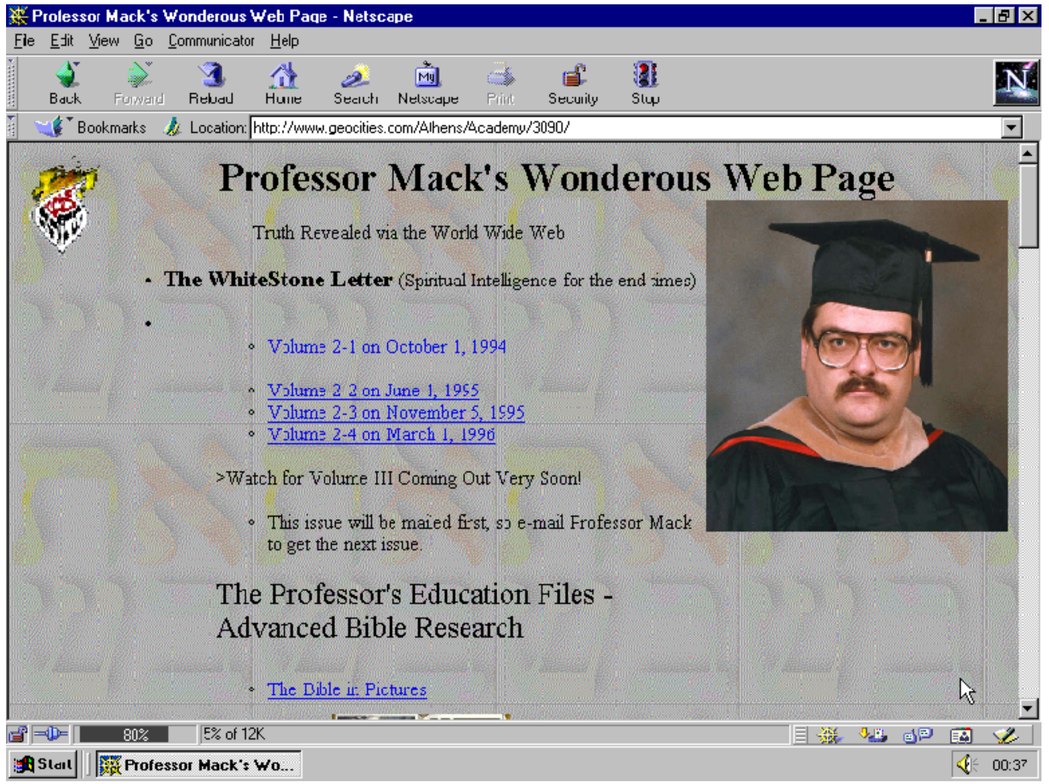
Timeline of AI Development

- **1950s-1960s**: First AI boom - the age of reasoning, prototype AI developed
- **1970s**: AI winter I
- **1980s-1990s**: Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- **1990s**: AI winter II
- **1997**: Deep Blue beats Gary Kasparov
- **2006**: University of Toronto develops Deep Learning
- **2011**: IBM's Watson won Jeopardy
- **2016**: Go software based on Deep Learning beats world's champions


Nonie's Leonardo Dicaprio Art Page - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
Bookmarks Location: http://www.geocities.com/Hollywood/9984/
Nonie's
Leonardo Dicaprio
Art Page
Hello and Welcome to Nonie's Leonardo Dicaprio Art Page !
So, You must be wondering - WHAT IS LEO ART ANYWAY ?!
Well - The answer is very simple folks: It's a collection of pictures I've made from alot of other pictures which are usually spread all around the net.
I've started doing these pictures after I've got some photo-editing
Document: Done
Start
Nonie's Leonardo Dic...
00:37

Type of information

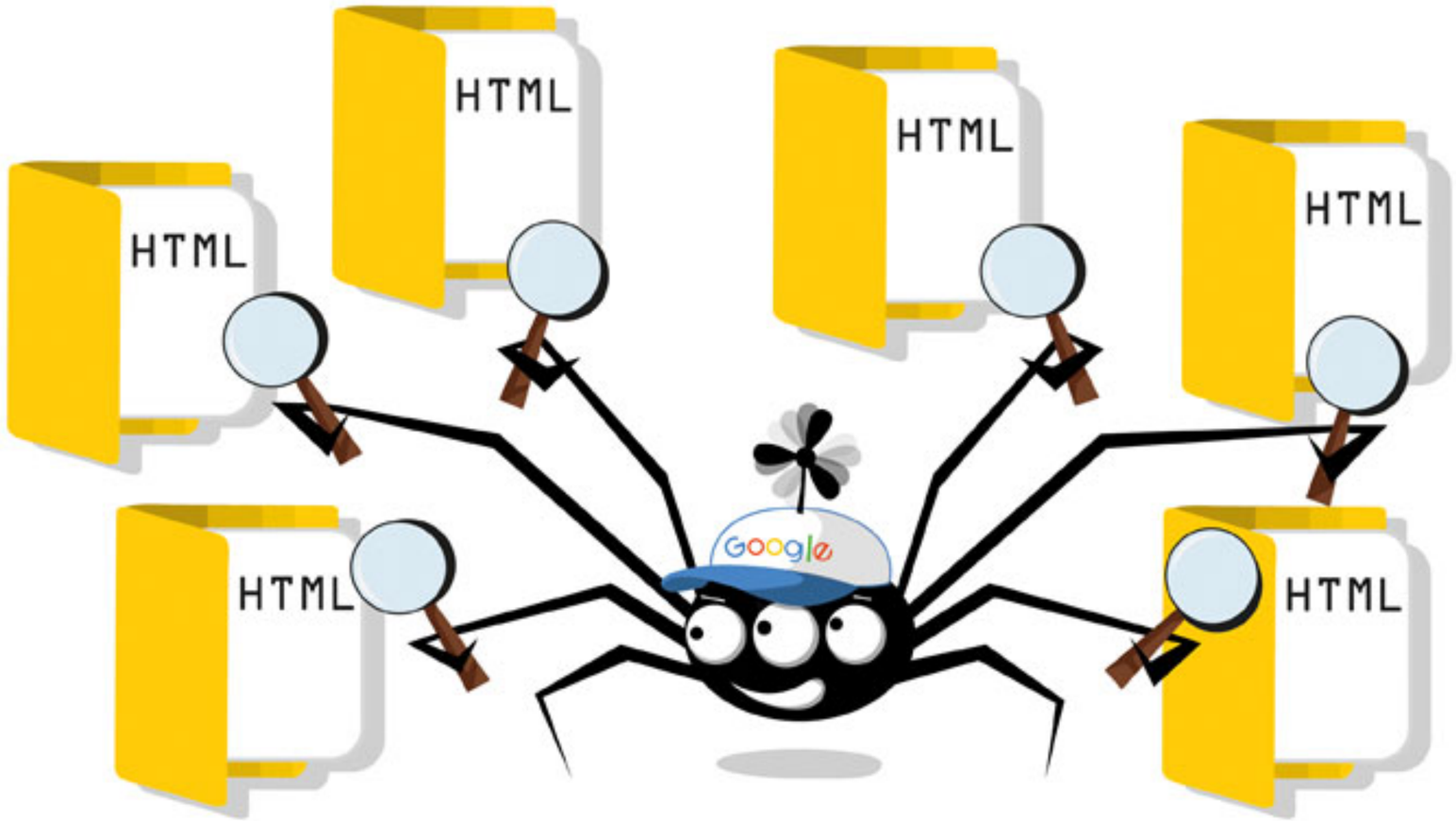




Directory

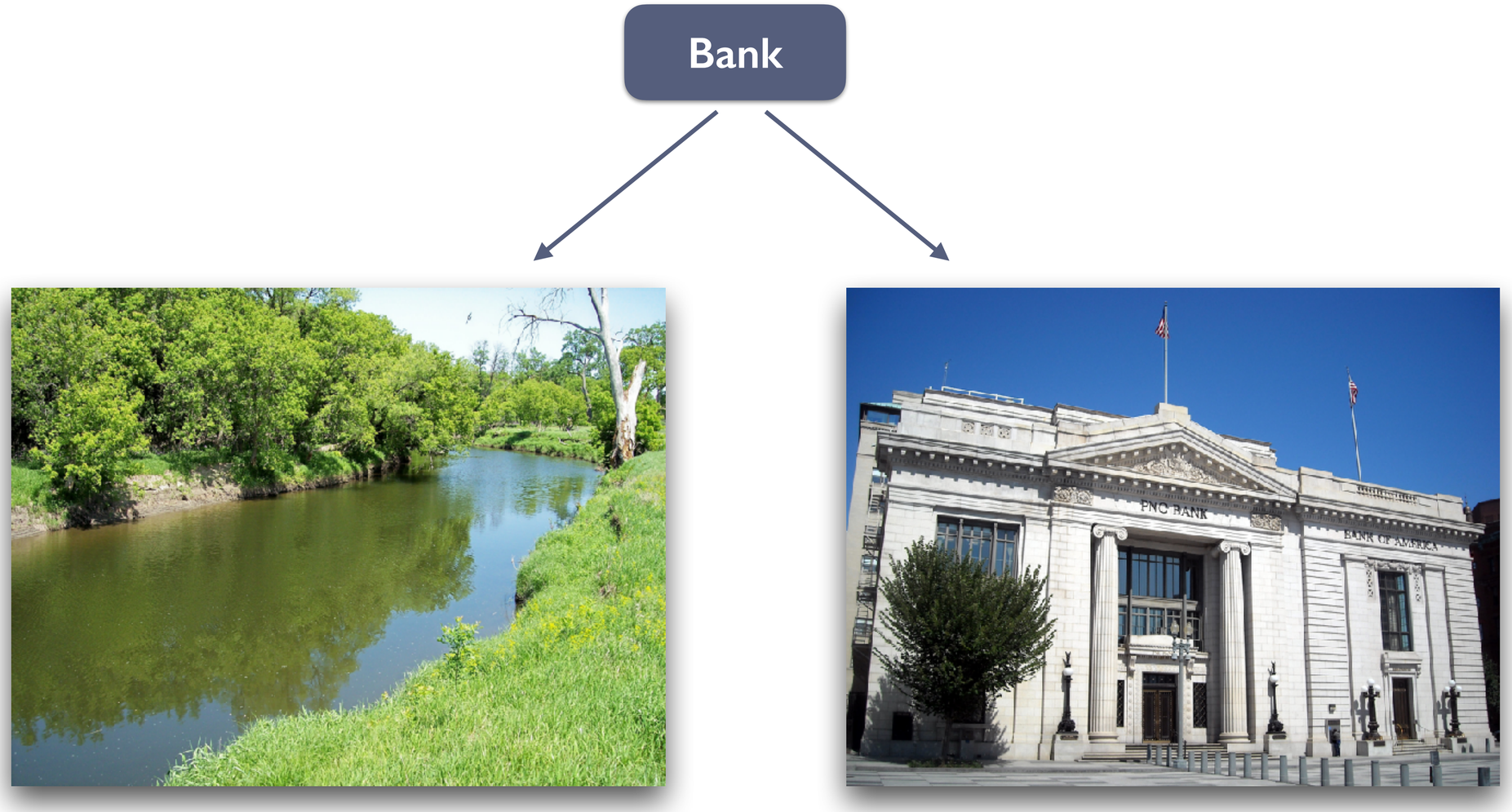
Information

Web crawling

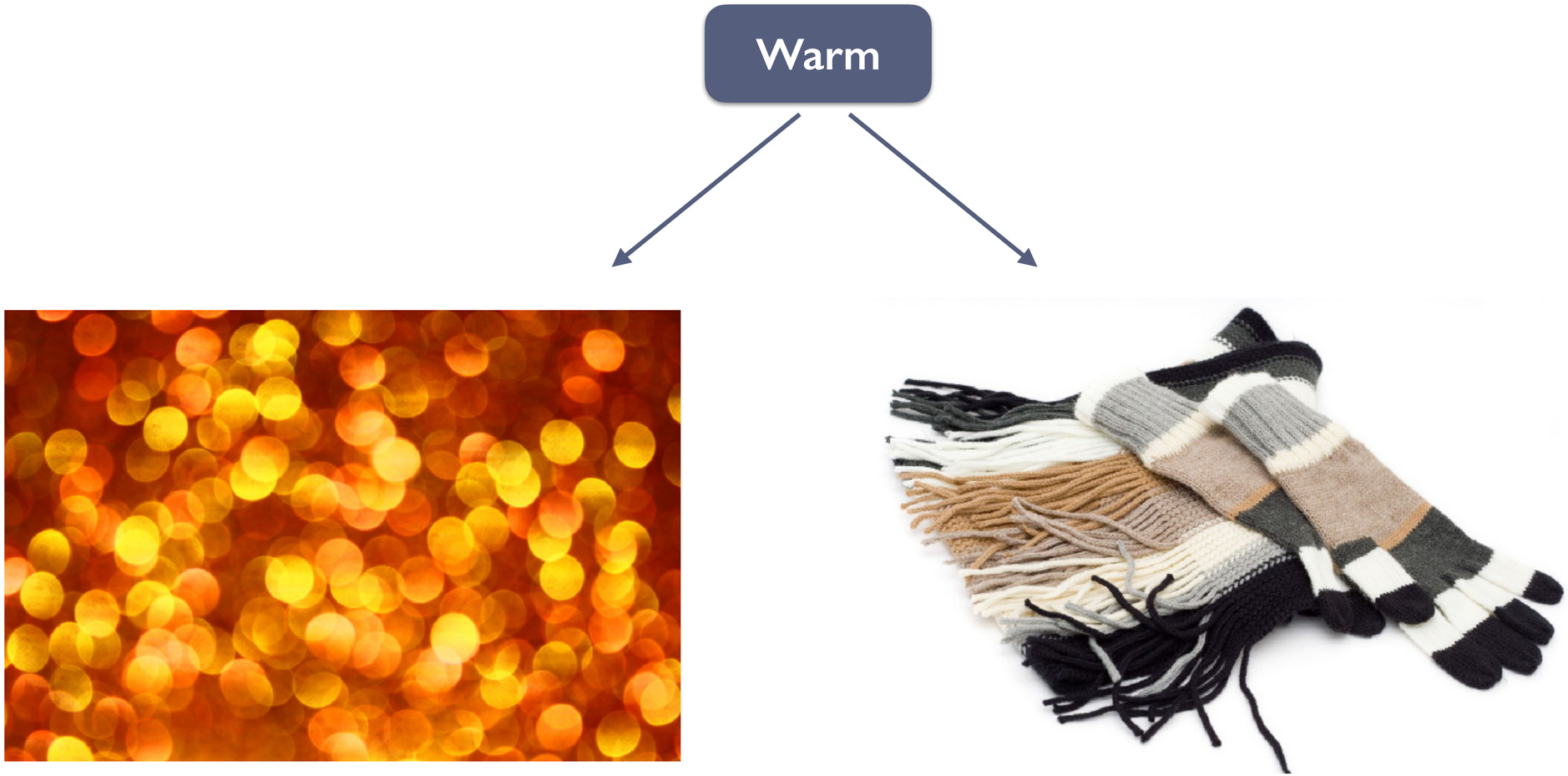



blue
it
gift
leave
pole
moment
sing
hine
clhim
whisper
time
size
may
beauty
eat

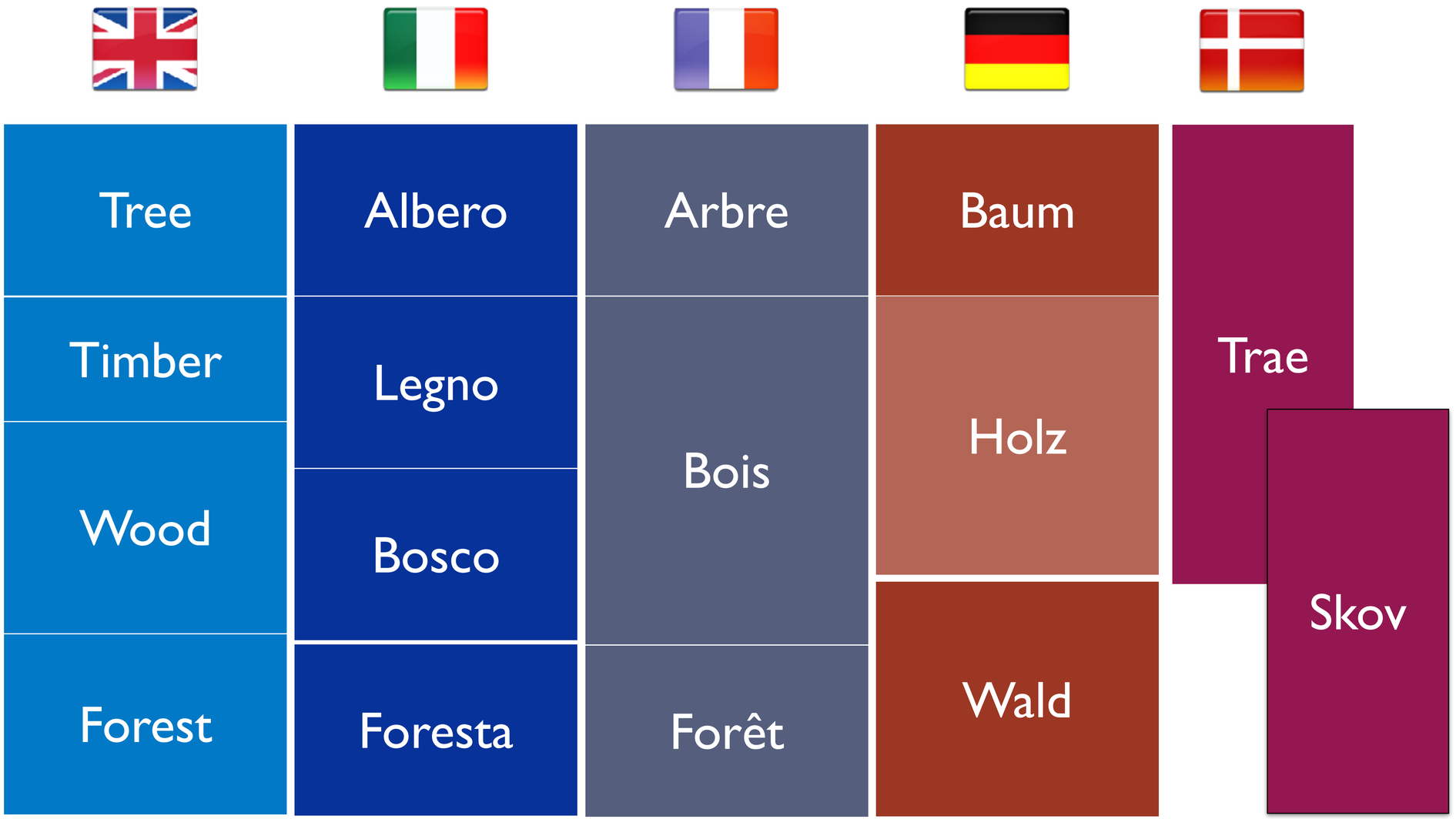
Problem: homonym



Problem: polysemy



Linguistic


Tree
Timber
Wood
Forest
Albero
Legno
Bosco
Foresta
Arbre
Bois
Forêt
Baum
Holz
Wald
Trae
Skov

Categorisation: what is a chair










Categorisation: what is a chair









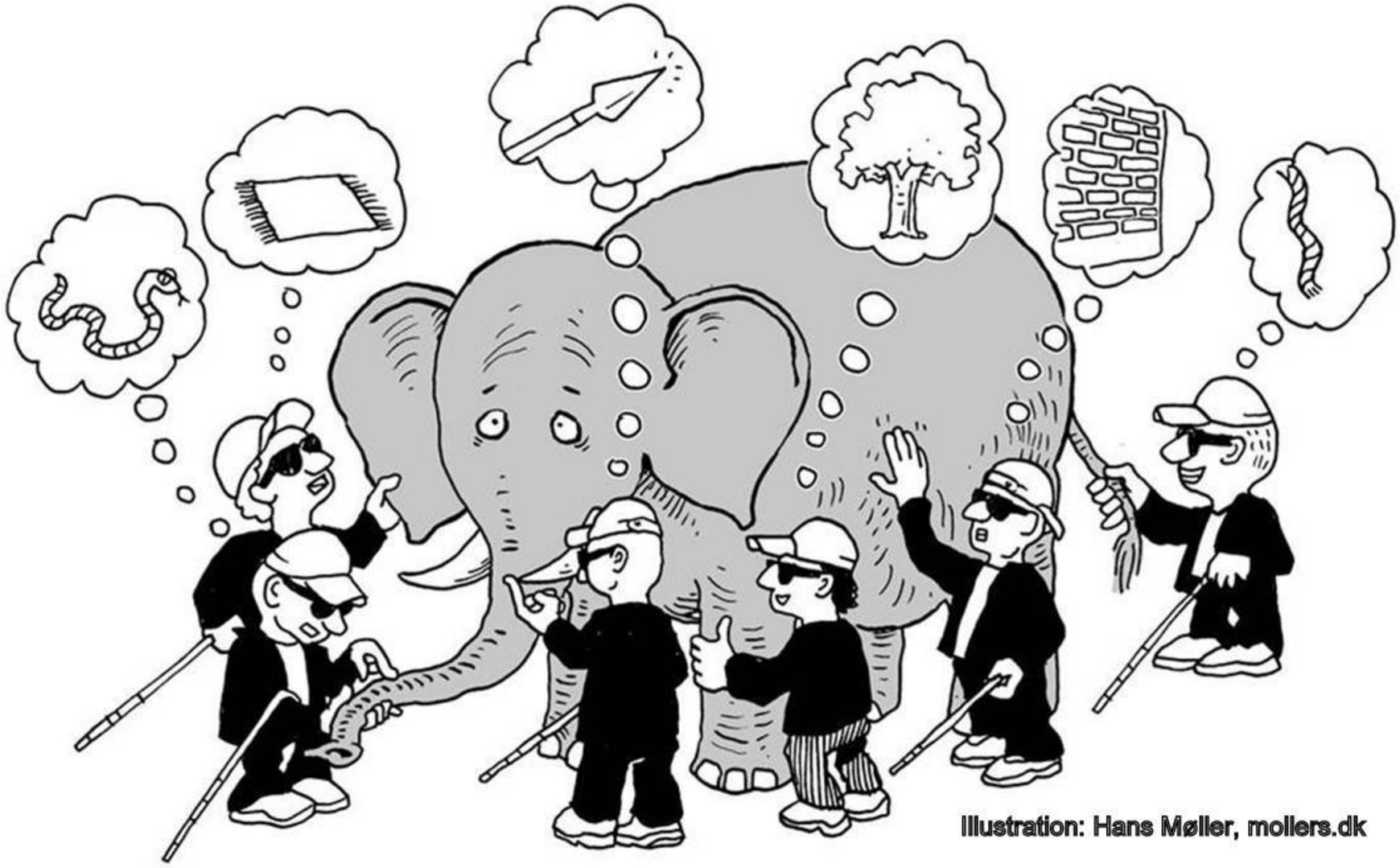
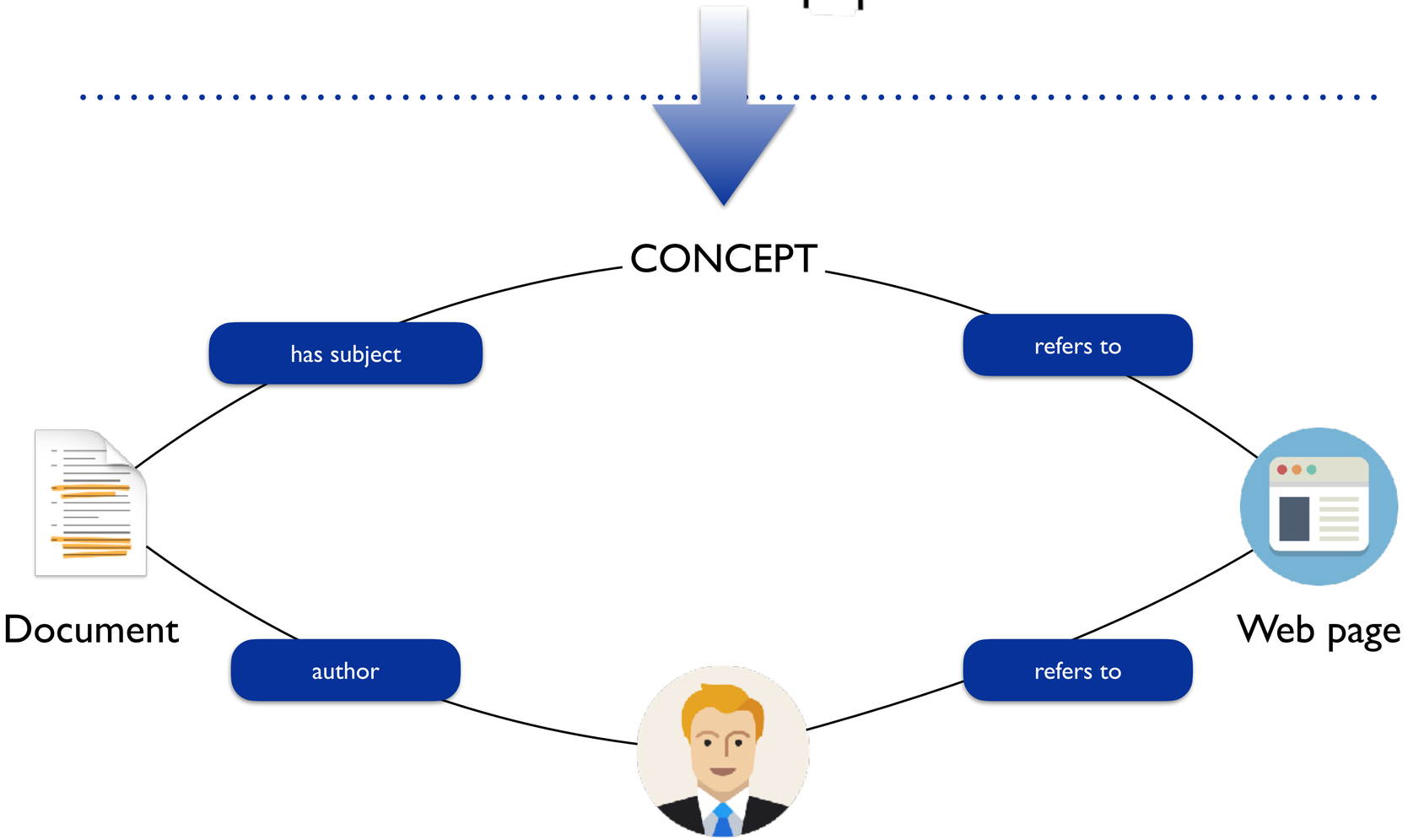
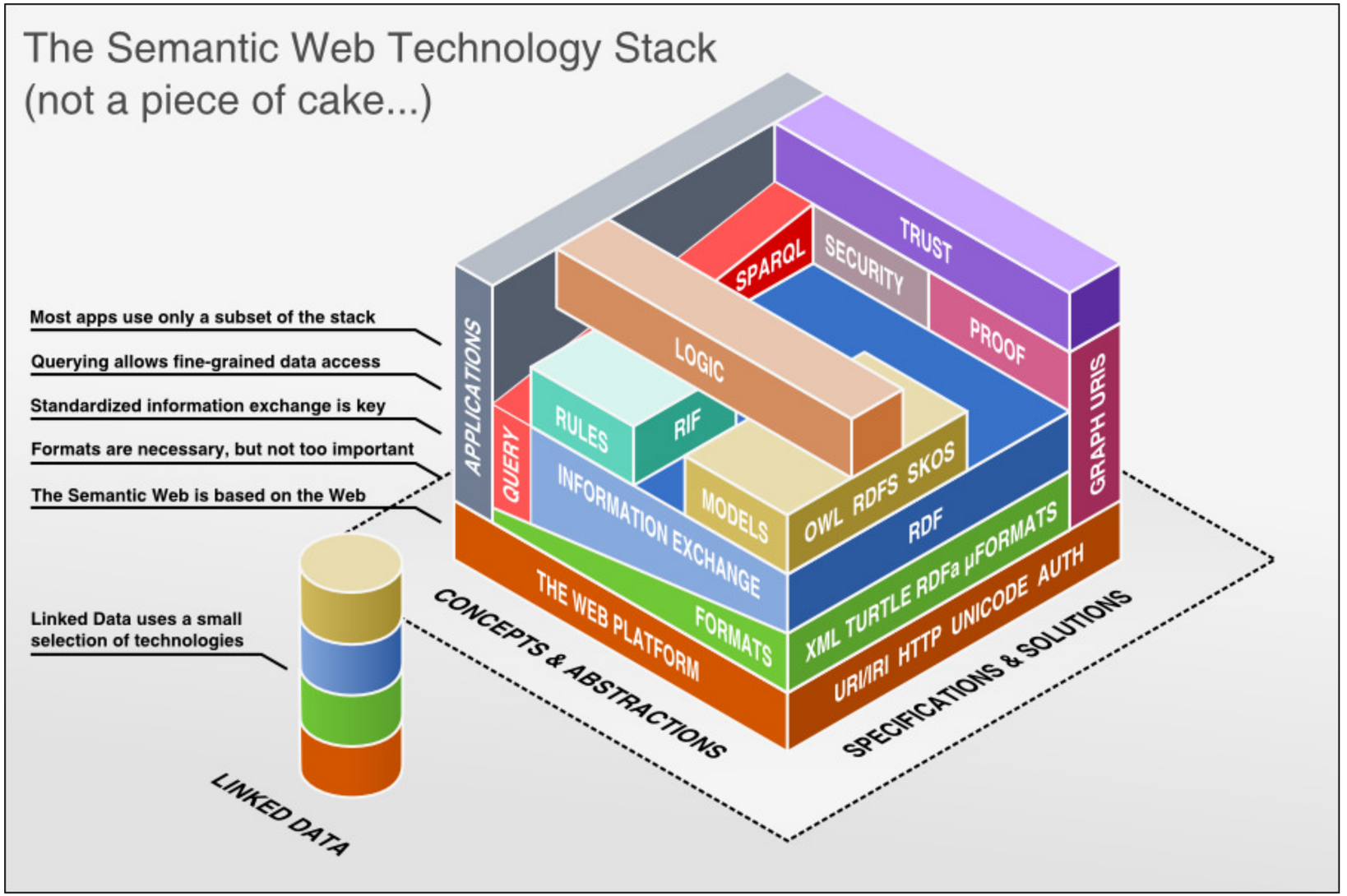



Illustration: Hans Møller, mollers.dk

Wikipedia


CONCEPT
has subject
refers to
Document
Web page
author
refers to
Person


The Semantic Web Technology Stack
(not a piece of cake...)
Most apps use only a subset of the stack
Querying allows fine-grained data access
Standardized information exchange is key
Formats are necessary, but not too important
The Semantic Web is based on the Web
Linked Data uses a small selection of technologies
LINKED DATA
APPLICATIONS
QUERY
SPARQL
TRUST
SECURITY
PROOF
LOGIC
RULES
RIF
INFORMATION EXCHANGE
MODELS
OWL RDFS SKOS
RDF
GRAPH URIS
THE WEB PLATFORM
FORMATS
XML TURTLE RDFa μFORMATS
URI/IRI HTTP UNICODE AUTH
CONCEPTS & ABSTRACTIONS
SPECIFICATIONS & SOLUTIONS

RDF: Resource Description Framework

- Data model: RDF
- Semantics: RDFS (Schema)
- Syntax: Turtle / RDFa/ RDF-XML

RDF: Resource Description Framework

- RDF is based on the idea of identifying things using Web identifiers (called Uniform Resource Identifiers, or URIs), and describing resources.
- A resource can be identified as a “thing” we want to talk about: a place, a person, a name, a webpage etc.
- Properties describe relationships between resource
- A statement declare to be composed by <s, o, p>

{Subject}	+ {Predicate}	+ {Object}
Nicola	*isA*	*Person*
Engine	*isPartOf*	*Car*
Things	*hasProperty*	*Value*
IRI	*IRI*	*IRI*

```
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ulan/500115892">
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cidoc-crm/E21_Person"/>
  <rdfs:label>Jacopo Torni</rdfs:label>
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collection.itatti.harvard.edu/resource/person/
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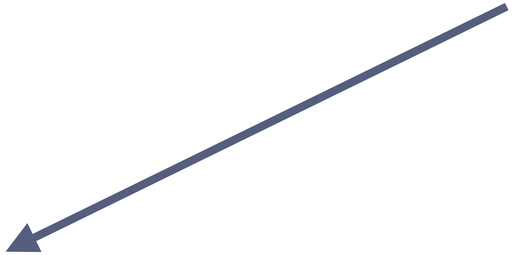
</rdf:Description>
```

<http://vocab.getty.edu/ulan/500115892>

<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>

<http://www.cidoc-crm.org/cidoc-crm/E21_Person>



<http://www.w3.org/2000/01/rdf-schema#label>

“Jacopo Torni”

<http://www.w3.org/2002/07/owl#sameas>

“http://www.wikidata.org/entity/Q2632655”^^<http://www.w3.org/2001/XMLSchema#anyURI>"

RDF: Resource Description Framework

- Predicates can be URI or Literals
- Literals are atomic values (strings or dates)
- A data type tells us whether we should interpret a value as string, a date, integer or some other type. It is recommend practice to use the data types defined by XML Schema
    - decimals - “1.23” <http://www.w3.org/2001/XMLSchema#decimal>
    - dates - ”1982-08-30”^^<http://www.w3.org/2001/XMLSchema#date>
    - String - “Jacopo Torni”

```
<https://collection.itatti.harvard.edu/resource/institution/P00006239> <http://www.cidoc-
crm.org/cidoc-crm/P74_has_current_or_former_residence> <https://
collection.itatti.harvard.edu/resource/institution/Ravello/P00006239> .
<https://collection.itatti.harvard.edu/resource/institution/Ravello/P00006239> <http://
www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://www.cidoc-crm.org/cidoc-crm/E53_Place>
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www.cidoc-crm.org/cidoc-crm/P87_is_identified_by> <https://collection.itatti.harvard.edu/
resource/institution/P00006239/Ravello/lng> .
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www.cidoc-crm.org/cidoc-crm/P87_is_identified_by> <https://collection.itatti.harvard.edu/
resource/institution/P00006239/Ravello/lat> .
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www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://www.cidoc-crm.org/cidoc-crm/
E47_Spatial_Coordinates> .
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E47_Spatial_Coordinates> .
<https://collection.itatti.harvard.edu/resource/institution/P00006239/Ravello/lat> <http://
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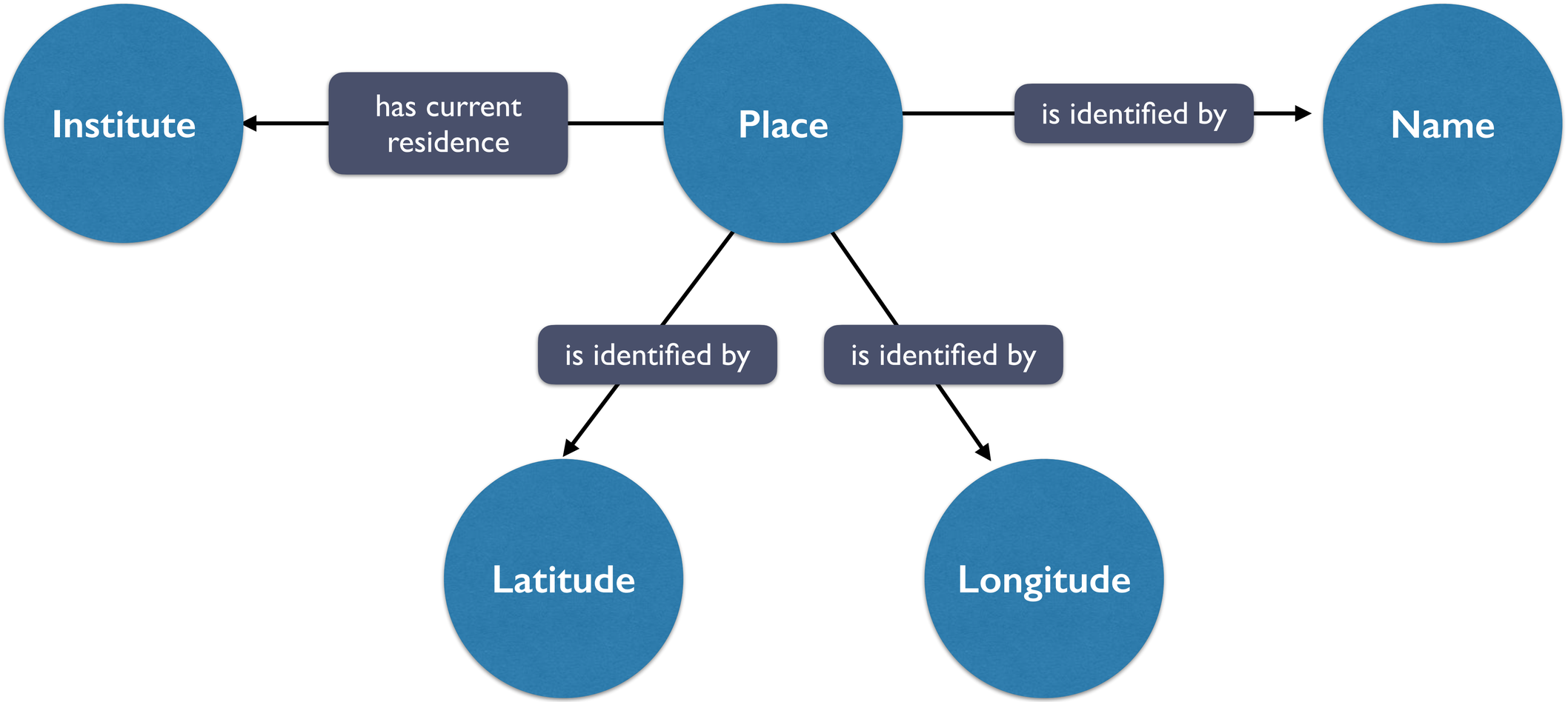
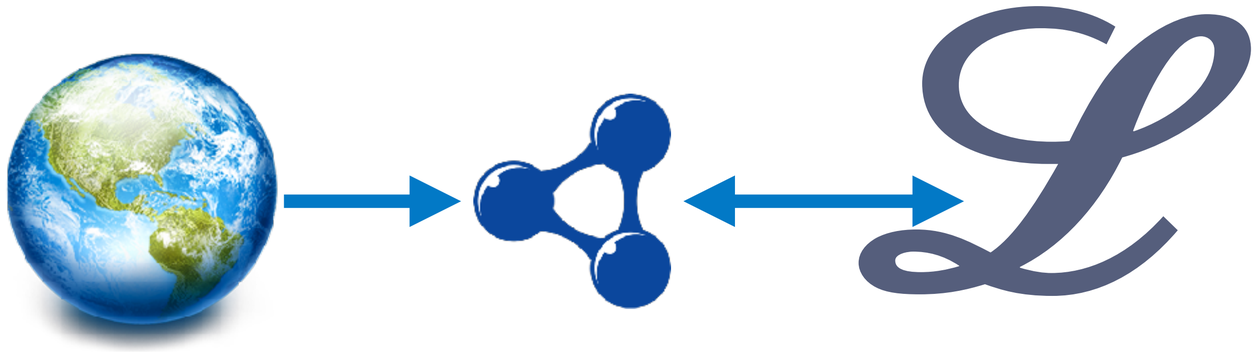

Institute
has current residence
Place
is identified by
Name
is identified by
is identified by
Latitude
Longitude

About the object



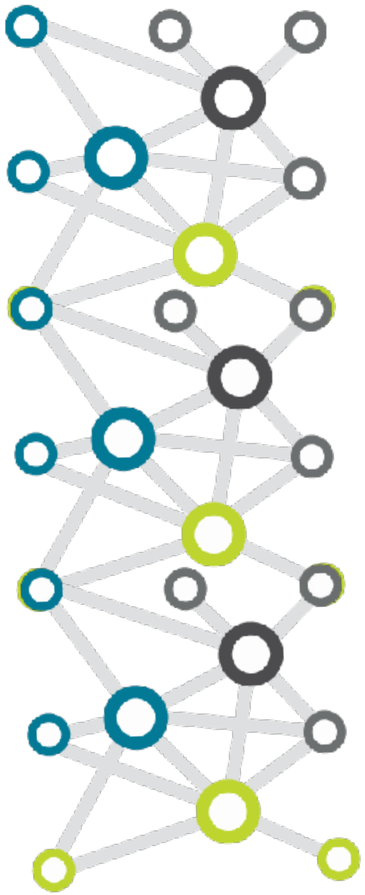
“An ontology is a formal, explicit specification of a shared conceptualization."

“logical theory accounting for the intended meaning of a formal vocabulary, i.e. its ontological commitment to a particular conceptualization of the world. The intended models of a logical language using such a vocabulary are constrained by its ontological commitment. An ontology indirectly reflects this commitment (and the underlying conceptualization) by approximating these intended models”

About the object

Language

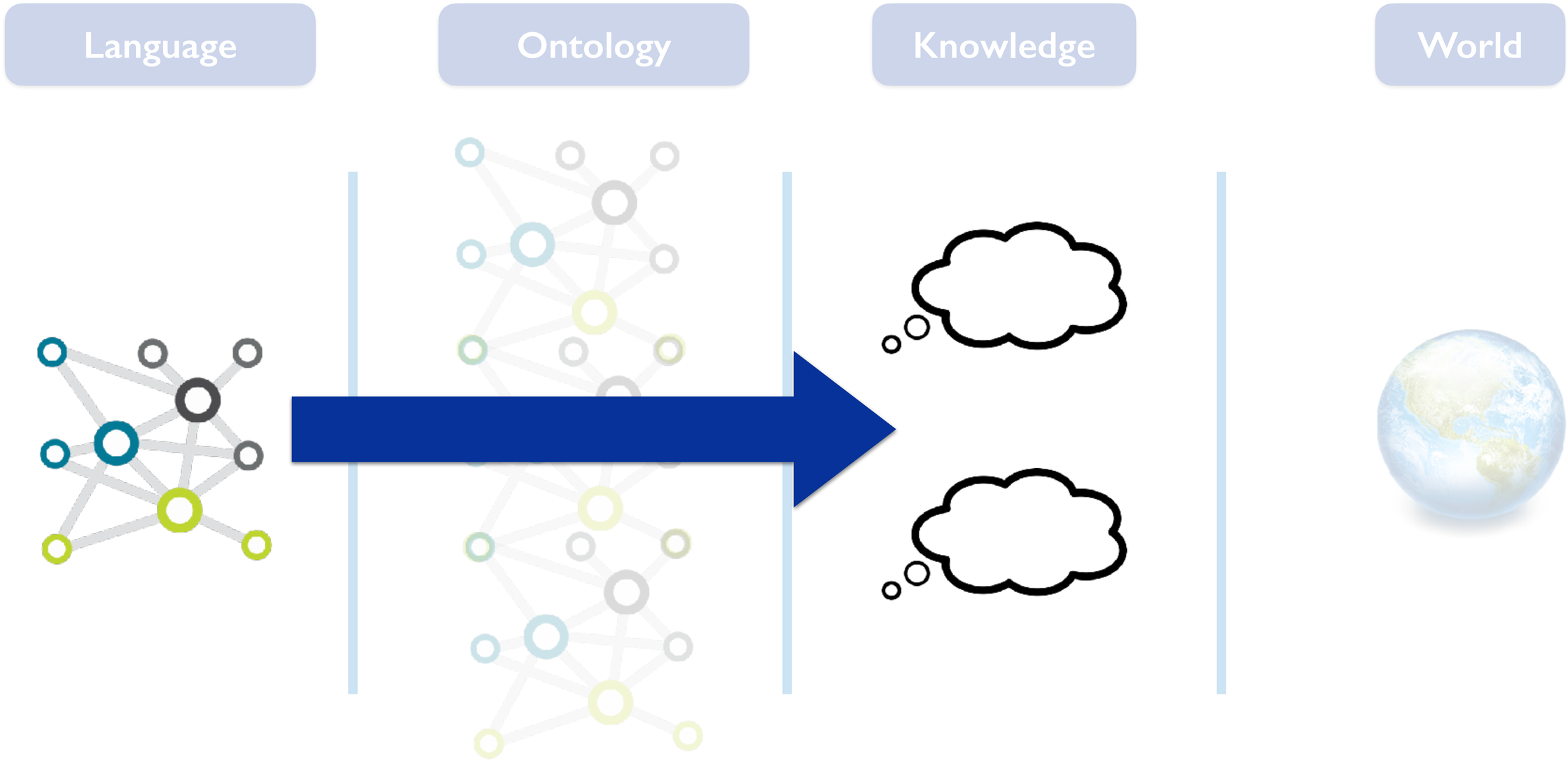
Ontology



Knowledge

World

Ontological commitment



Classes and properties

Class

"A category of items that share one or more common traits serving as criteria to identify the items belonging to the class. "

Property

"A property serves to define a relationship of a specific kind between two classes […] A property plays a role analogous to a grammatical verb, in that it must be defined with reference to both its domain and range, which are analogous to the subject and object in grammar."

Instance

An instance of a class is a real world item that fulfils the criteria of the intension of the class

```
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ulan/500115892">
  <rdf:type rdf:resource="http://www.cidoc-crm.org/
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  <rdfs:label>Jacopo Torni</rdfs:label>
  <crm:P129i_is_subject_of rdf:resource="https://
collection.itatti.harvard.edu/resource/person/
A00001629/hollis"/>
```

<http://vocab.getty.edu/ulan/500115892> <http://www.cidoc-crm.org/cidoc-crm/E21_Person>