Knowledge Editors & Languages and in Webstructor and Agents®
+ Graph Engines for Uncertain Inference

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*THE REAL SCIENCE

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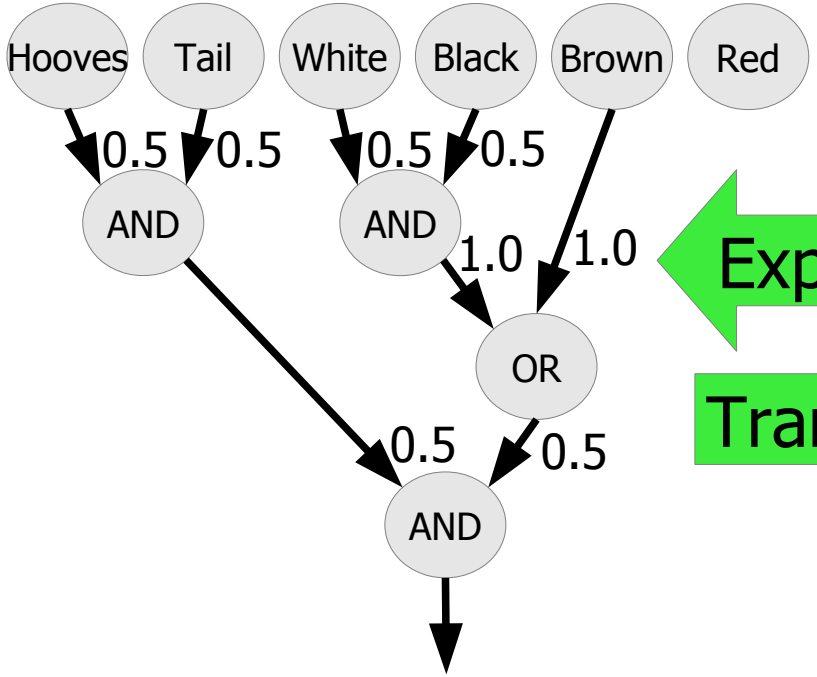
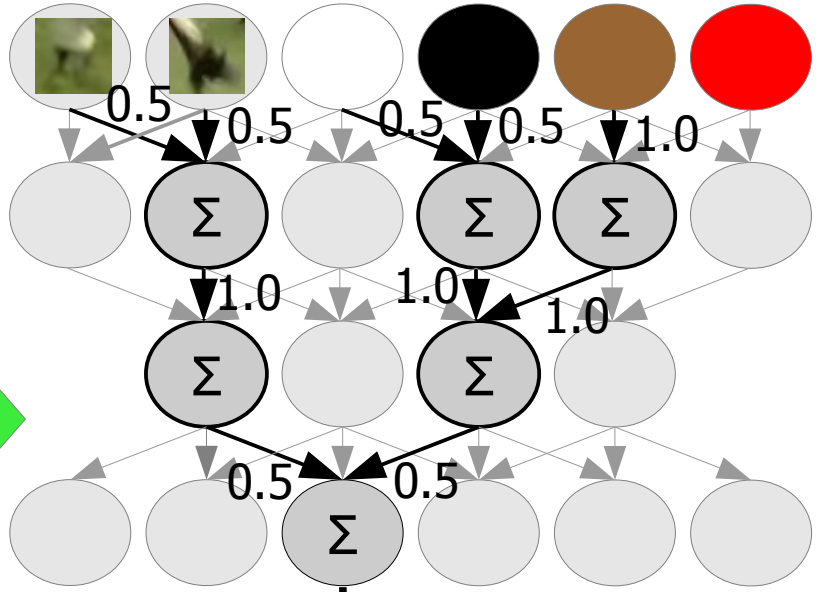
Bridging the Symbolic-Subsymbolic gap for "explainable AI" and "transfer learning"



Explain

Transfer



(Hooves AND Tail) AND
((White and Black) OR Brown)

=> Horse

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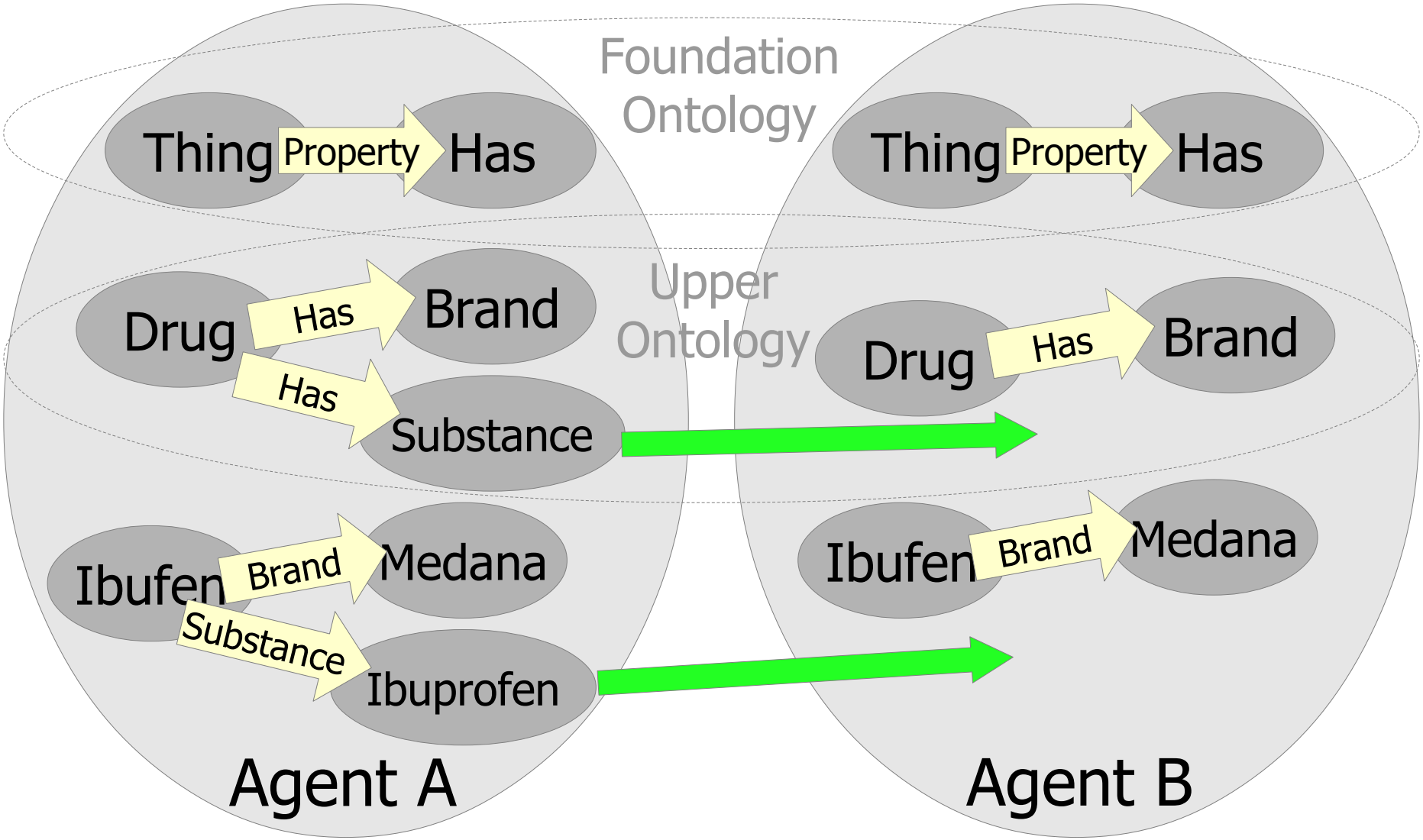
Foundation Ontologies for Distributed (Multi-Agent) Systems



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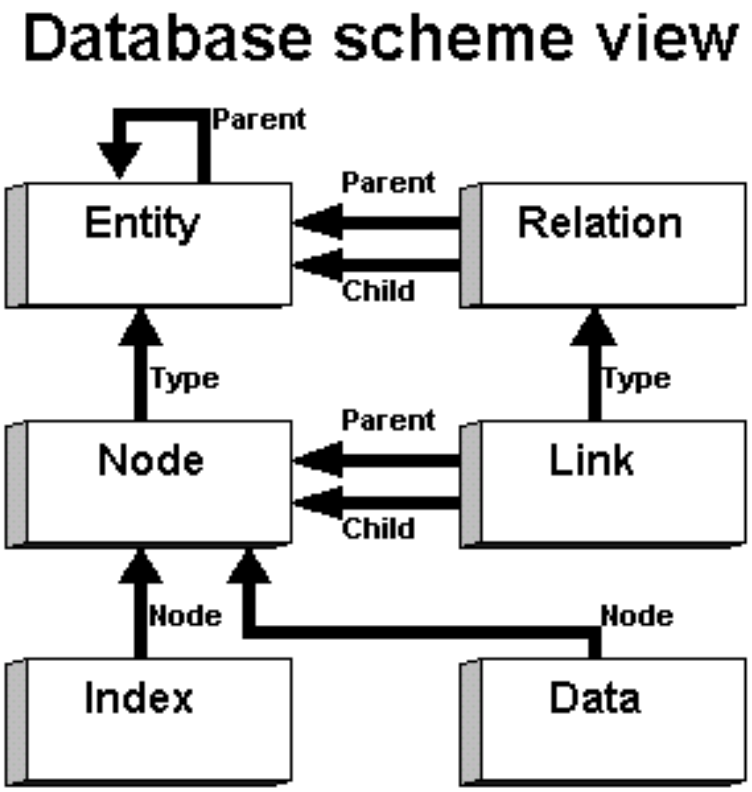
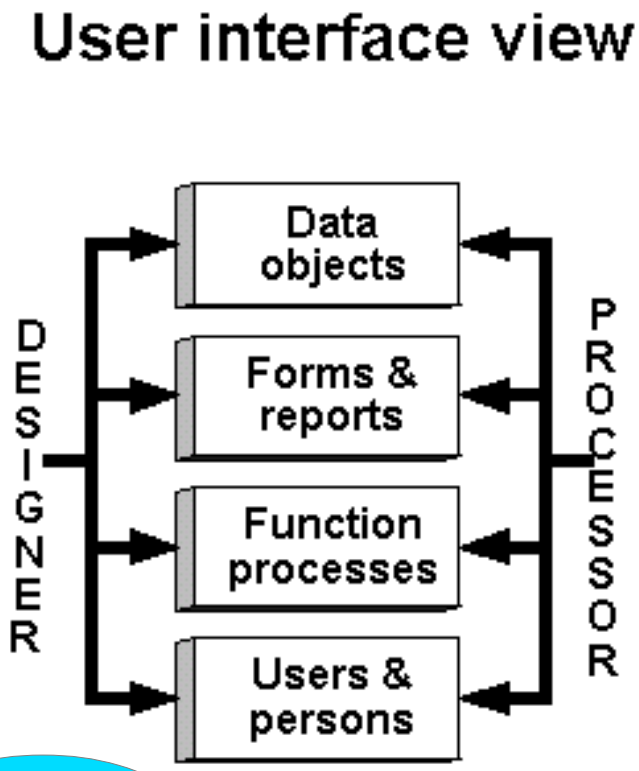
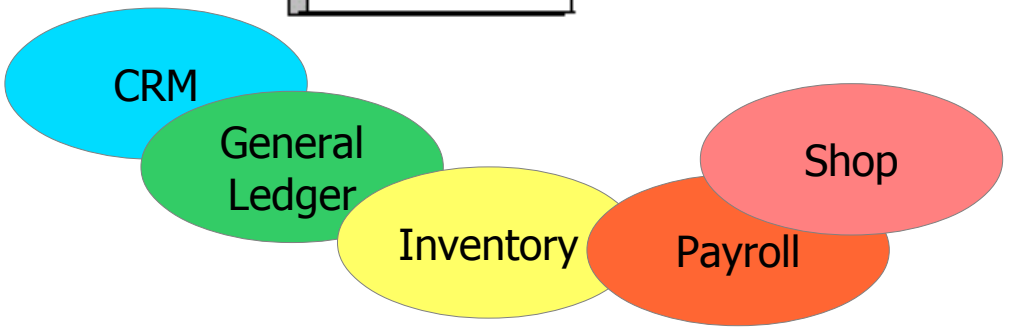
Foundation Ontologies - Applications





Data4: 1995



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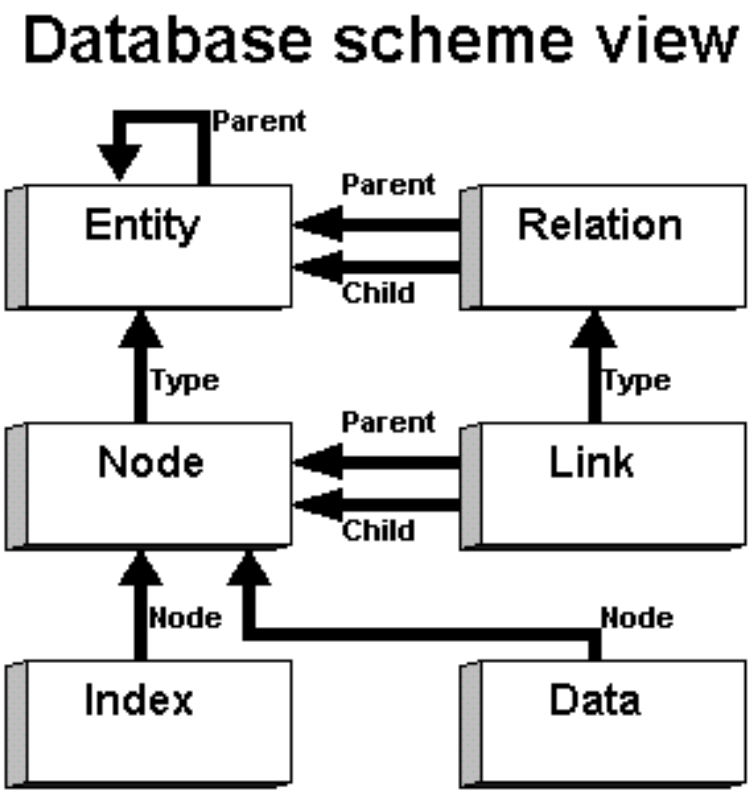
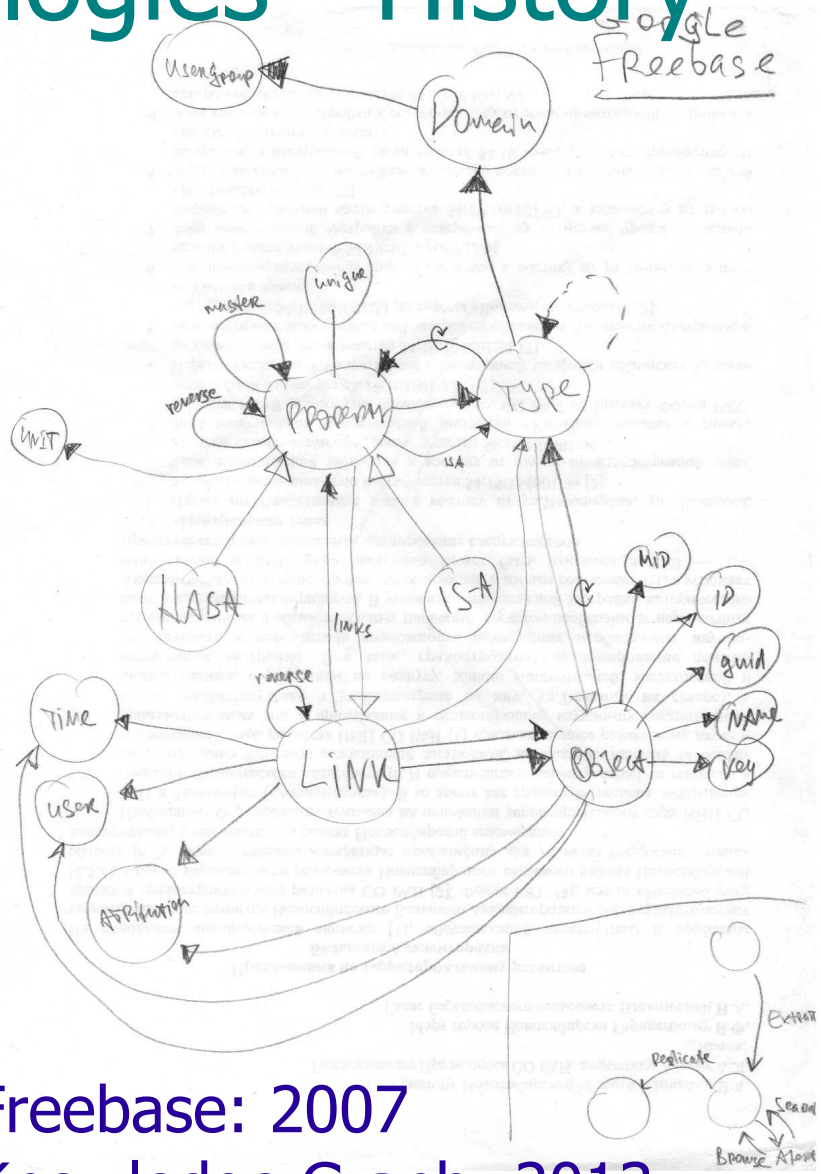
Foundation Ontologies - History



Data4: 1995



Freebase: 2007
Knowledge Graph: 2013

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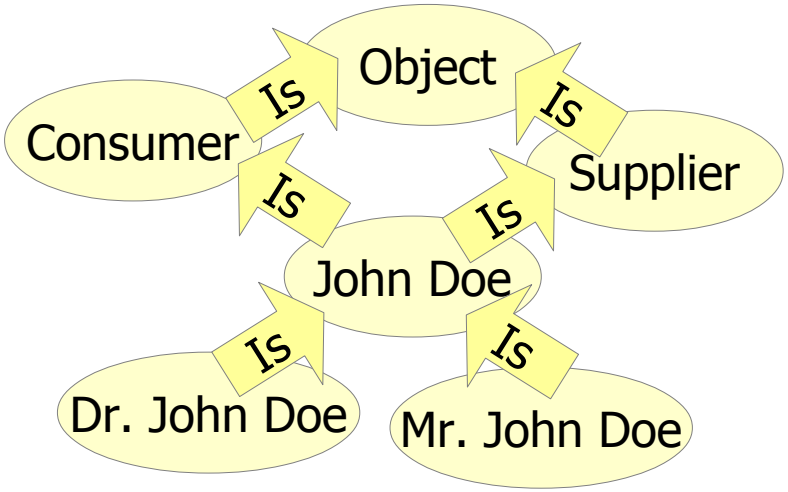
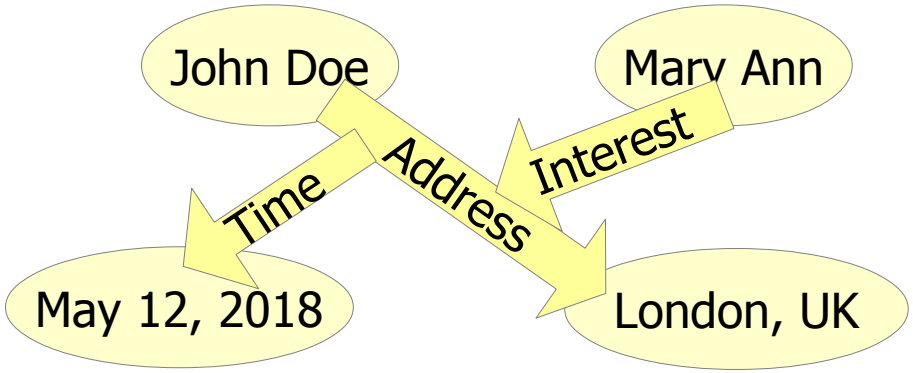
Lessons Learned:

1. Class is an Object

2. Object may be a Class

3. Link can be a Node





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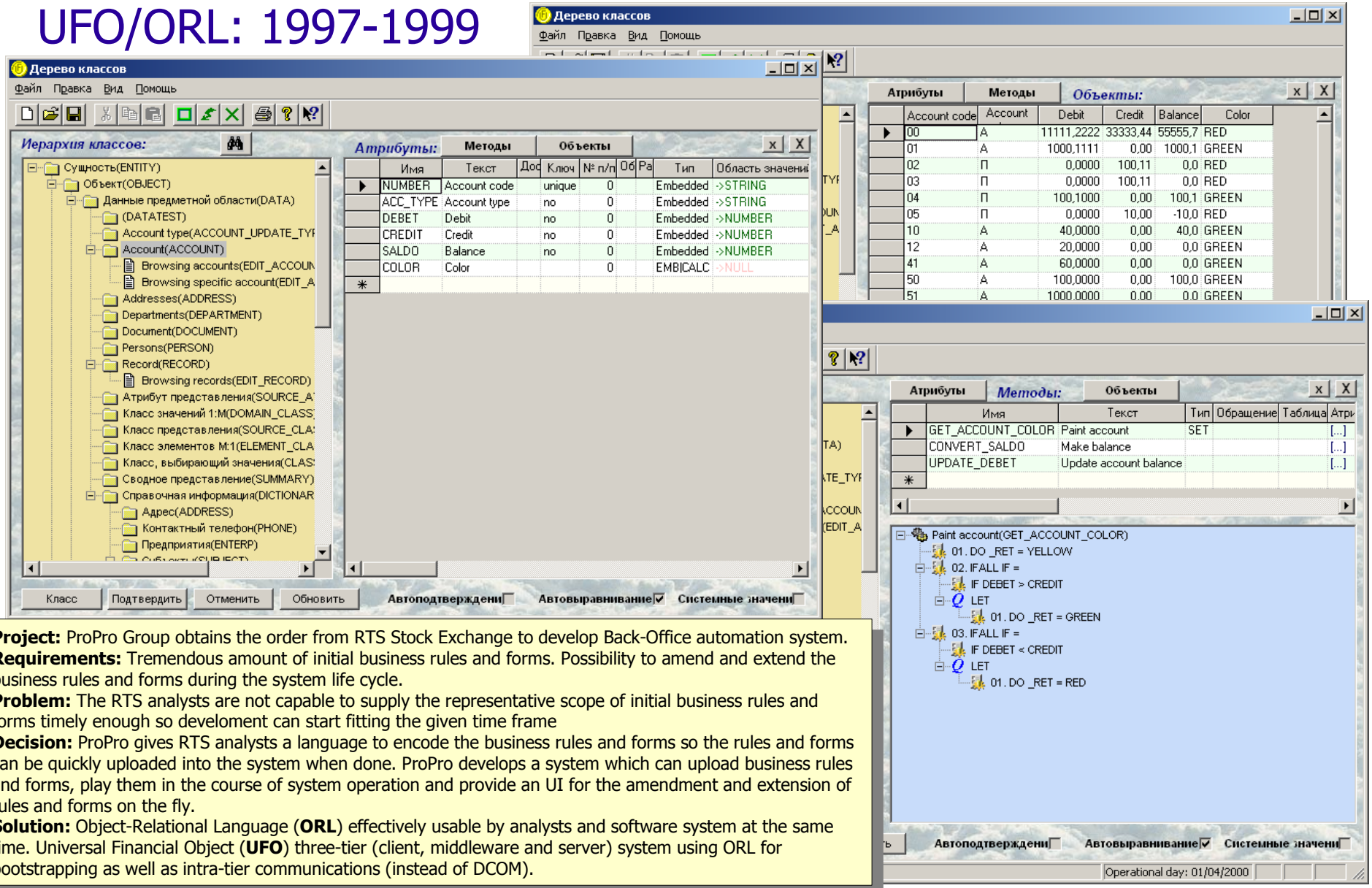
Semantic Modeling of Business Processes

UFO/ORL: 1997-1999



Project: ProPro Group obtains the order from RTS Stock Exchange to develop Back-Office automation system.
Requirements: Tremendous amount of initial business rules and forms. Possibility to amend and extend the business rules and forms during the system life cycle.
Problem: The RTS analysts are not capable to supply the representative scope of initial business rules and forms timely enough so develoment can start fitting the given time frame
Decision: ProPro gives RTS analysts a language to encode the business rules and forms so the rules and forms can be quickly uploaded into the system when done. ProPro develops a system which can upload business rules and forms, play them in the course of system operation and provide an UI for the amendment and extension of rules and forms on the fly.
Solution: Object-Relational Language (**ORL**) effectively usable by analysts and software system at the same time. Universal Financial Object (**UFO**) three-tier (client, middleware and server) system using ORL for bootstrapping as well as intra-tier communications (instead of DCOM).

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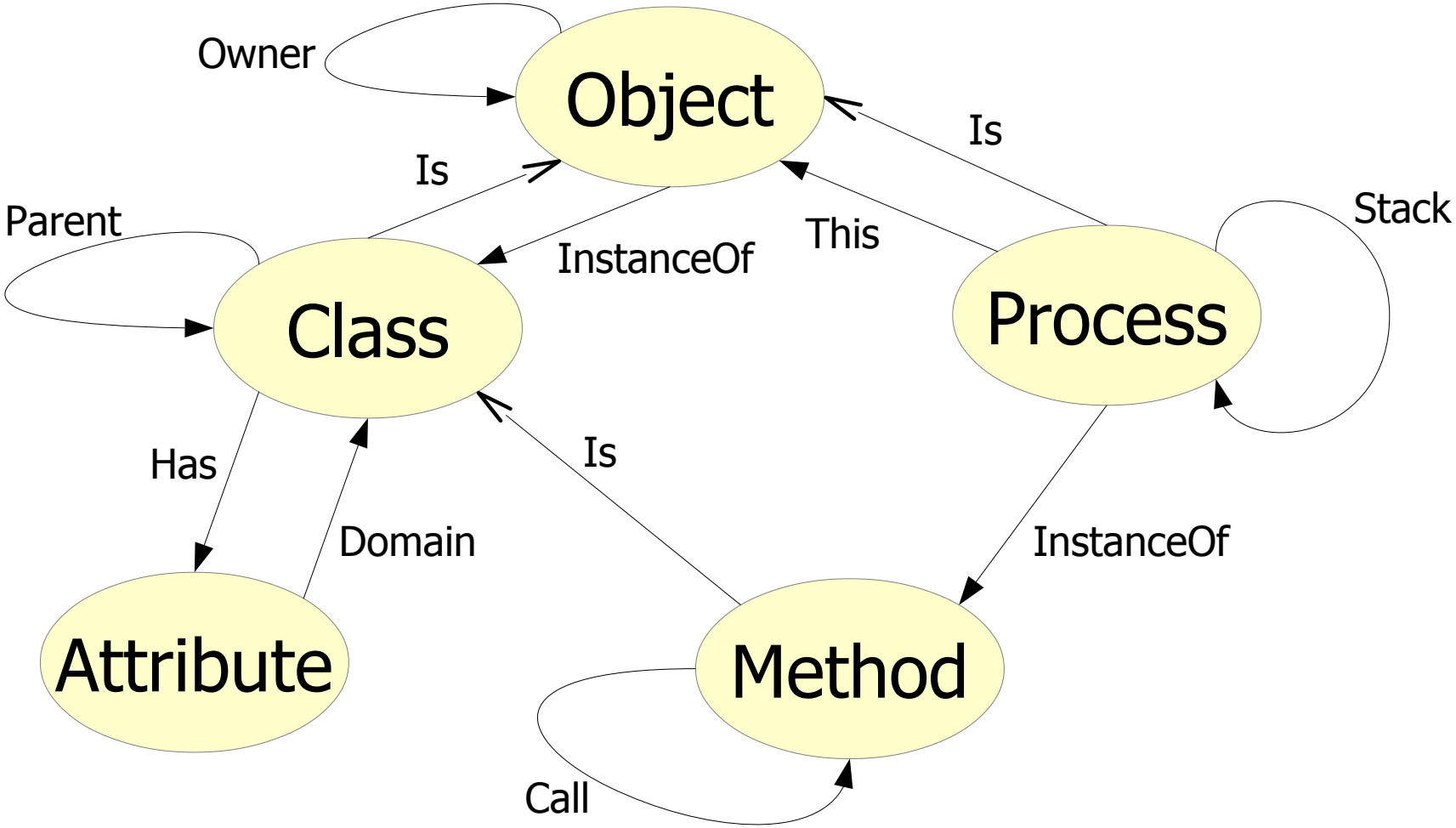
Semantic Modeling of Business Processes

UFO/ORL: 1997-1999

Foundation Ontology



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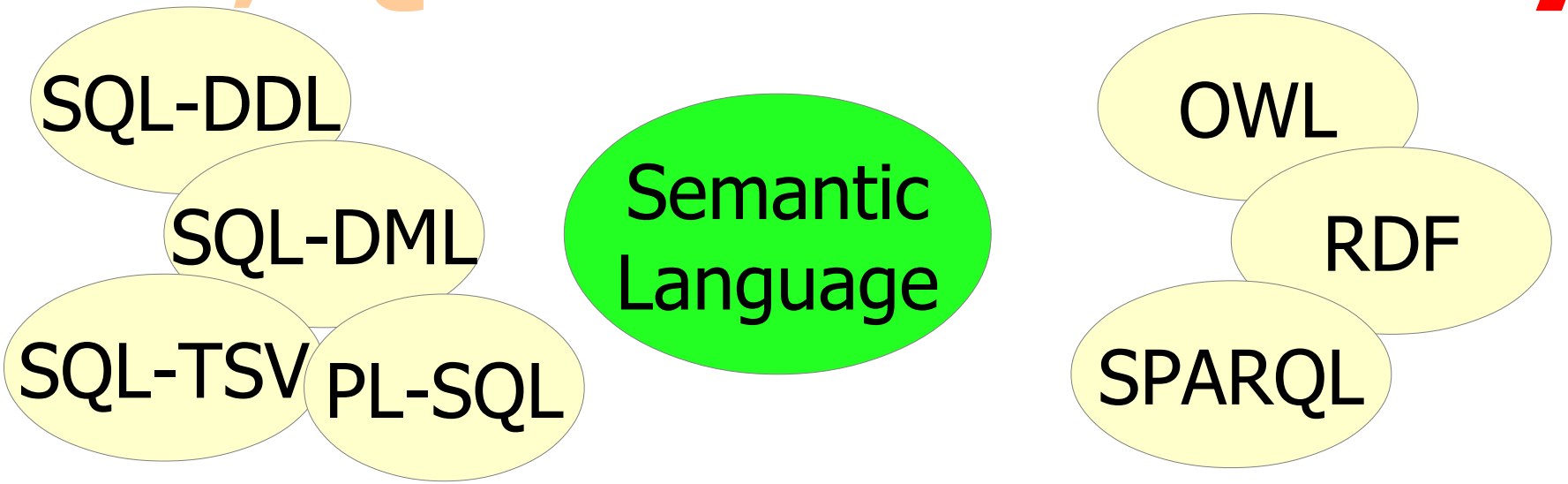
Lesson Learned:

Can have **only one**, language for **DDL, DML, PL, QL** instead of **many**.



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Semantic Modeling of Business Processes

Object Relational Language (ORL)

English	ORL
Here are the items A, B and C where A has properties X and Y while B and C are in relationship Z.	ITEM A,B,C;; A HAS (X), (Y);; B Z(C);;
In order to reach goal 1 one needs condition 2 and 3 to be held true while 2 can be true only if condition 4 happens.	CONDITION C2,C3,C4;; GOAL G1 REQUIRES (C2),(C3);; CONDITION(C2) REQUIRES (C4);;
Each morning need to perform this and that in order, having such and such done at once next.	PROCESS TIME “8:00”; REPEAT (DAILY); ORDER DO THIS, DO THAT;, FORK DO SUCH, DO SUCH;;;
What is that my stuff you mentioned yesterday or the day before?	STUFF(OWNER (ME), UPDATE (AUTHOR (YOU), {TIME “2013-03-22”, TIME “2013-03-21”}).TELL;
What were the relationships between P and Q last year?	PROPERTY(OWNER (P), THING (Q), TIME “2012”).TELL;
Let me know once they roll out next version of the product.	DO EMAIL TO “me@at.org”;; WHEN PRODUCT(VENDOR (THEY)).VERSION CHANGE;;

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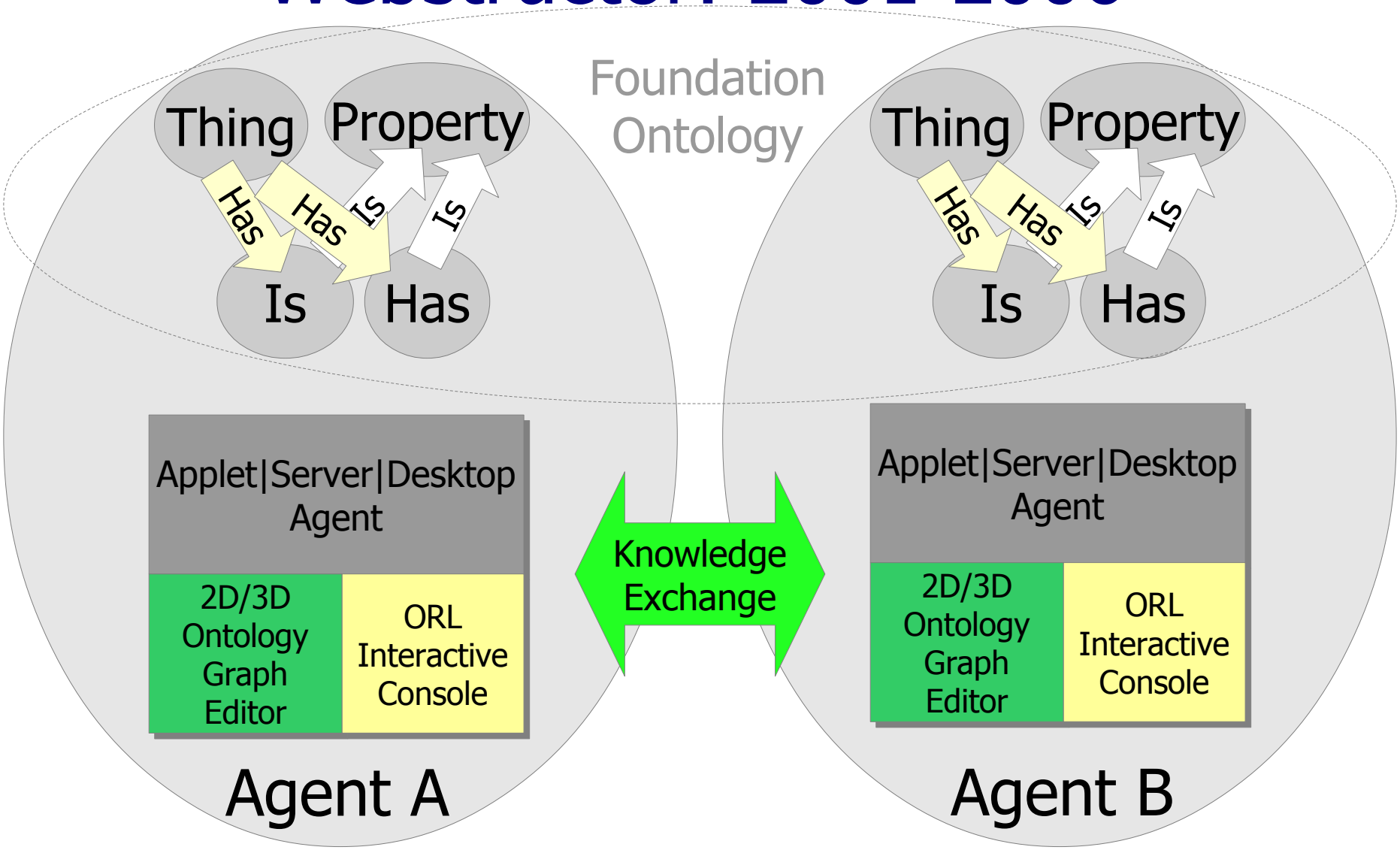
Distributed Knowledge Editor
Webstructor: 2001-2006



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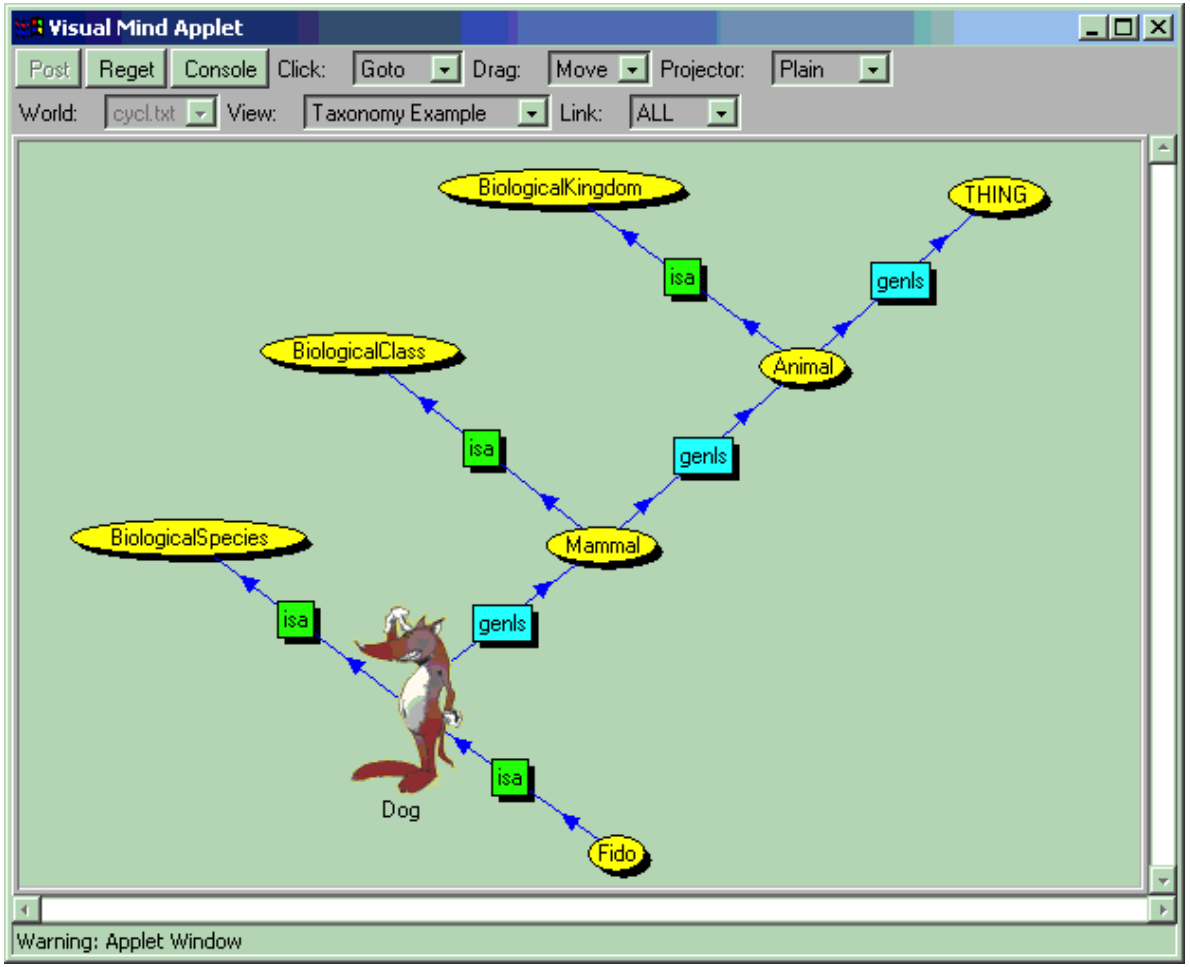
Webstructor: Distributed Knowledge Editor

Visual ontology editor - representing Cyc «micro-theory»



Fragment of «biological kingdom» of Cyc «upper ontology»

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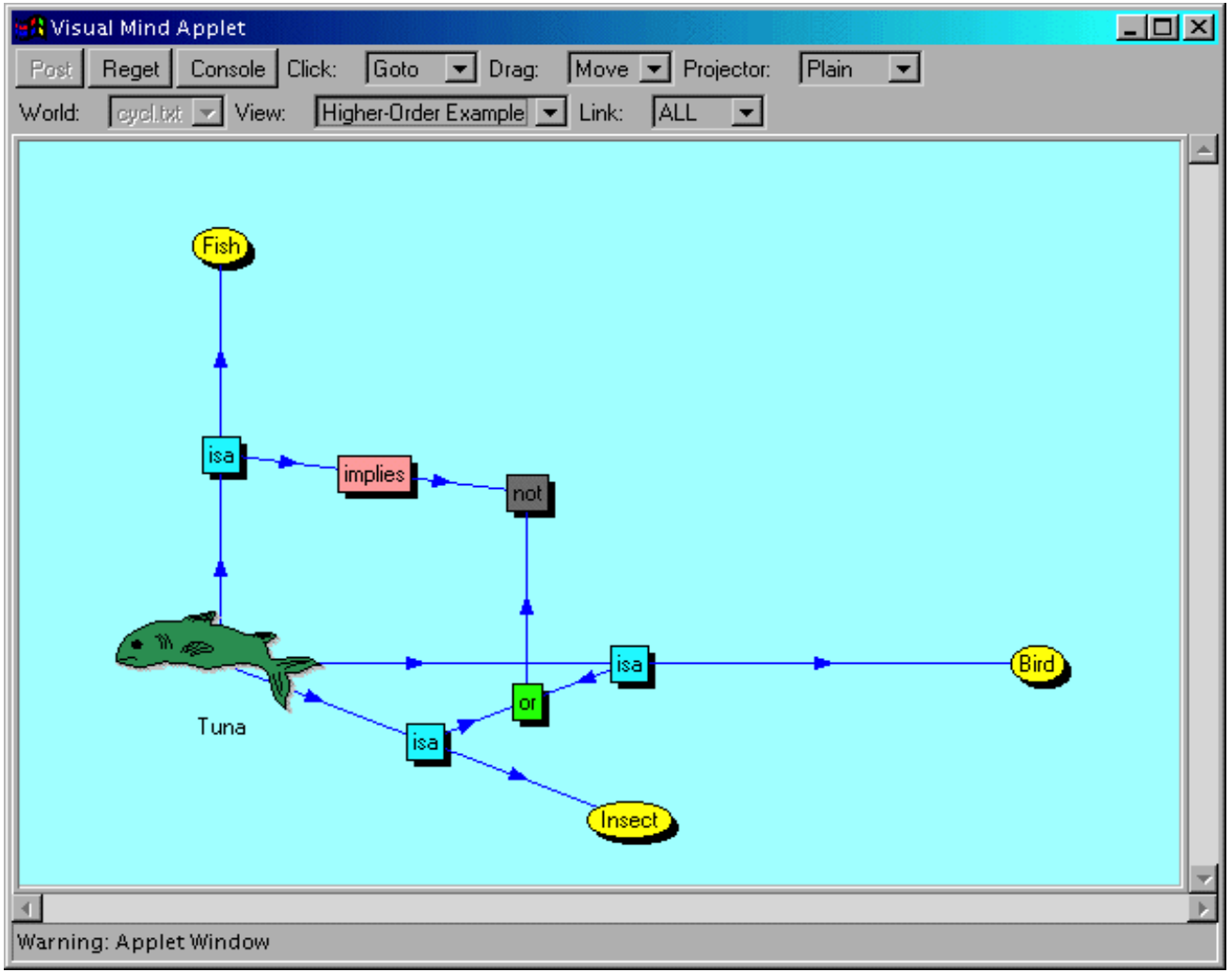
Visual ontology and predicate logic formula editor



Expression: «If tuna is a fish, that implies it is not an insect or a bird.»

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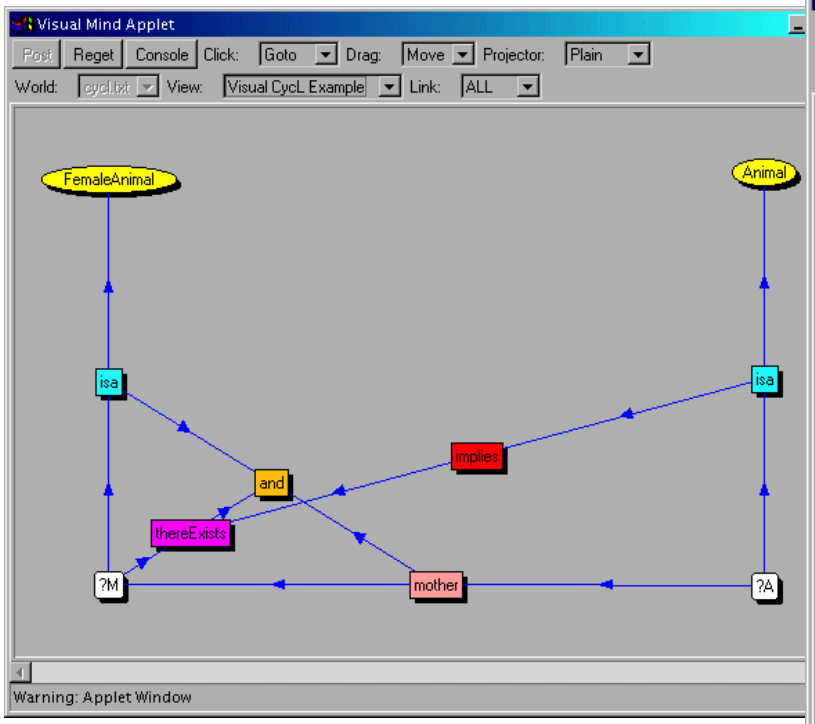
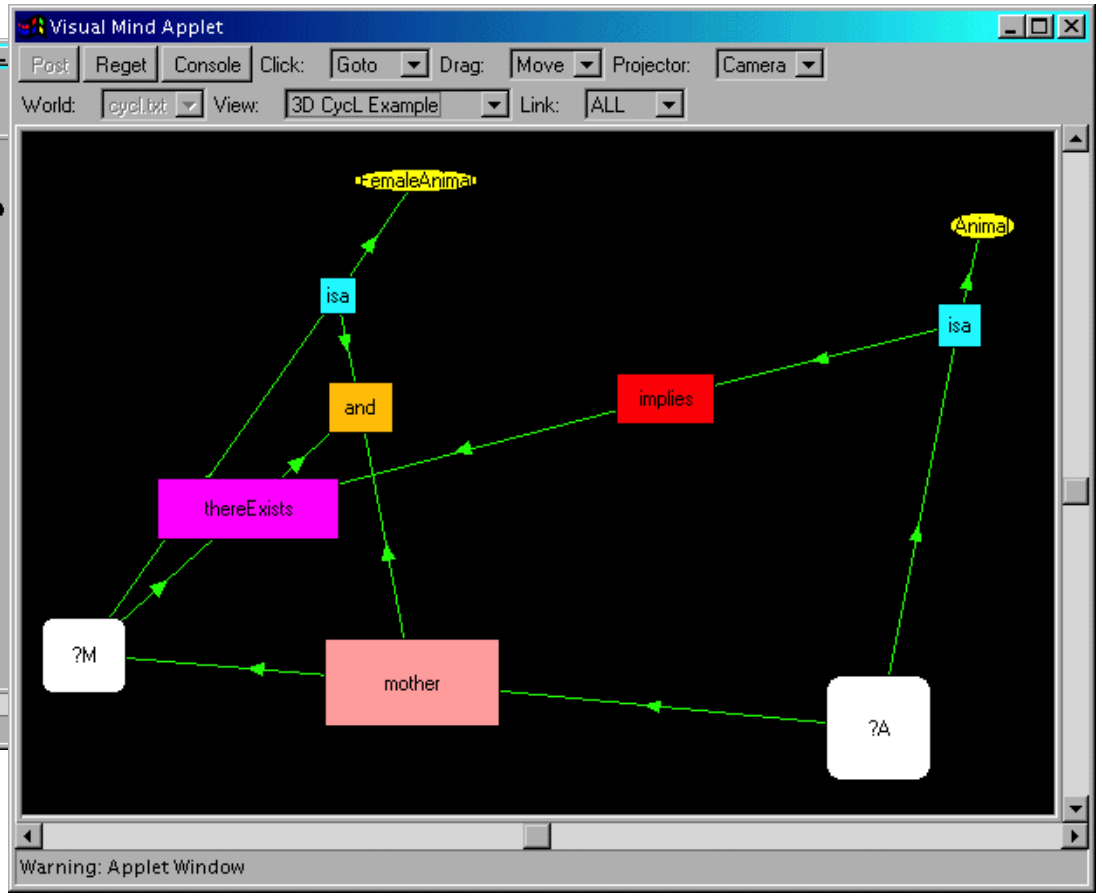
Webstructor: Distributed Knowledge Editor

Visual 2D/3D editor of logical assertions (e.g. CycL)





(implies (isa ?A Animal) (thereExists ?M (and (mother ?A ?M) (isa ?M FemaleAnimal))))
= Mother of an animal is a female animal.

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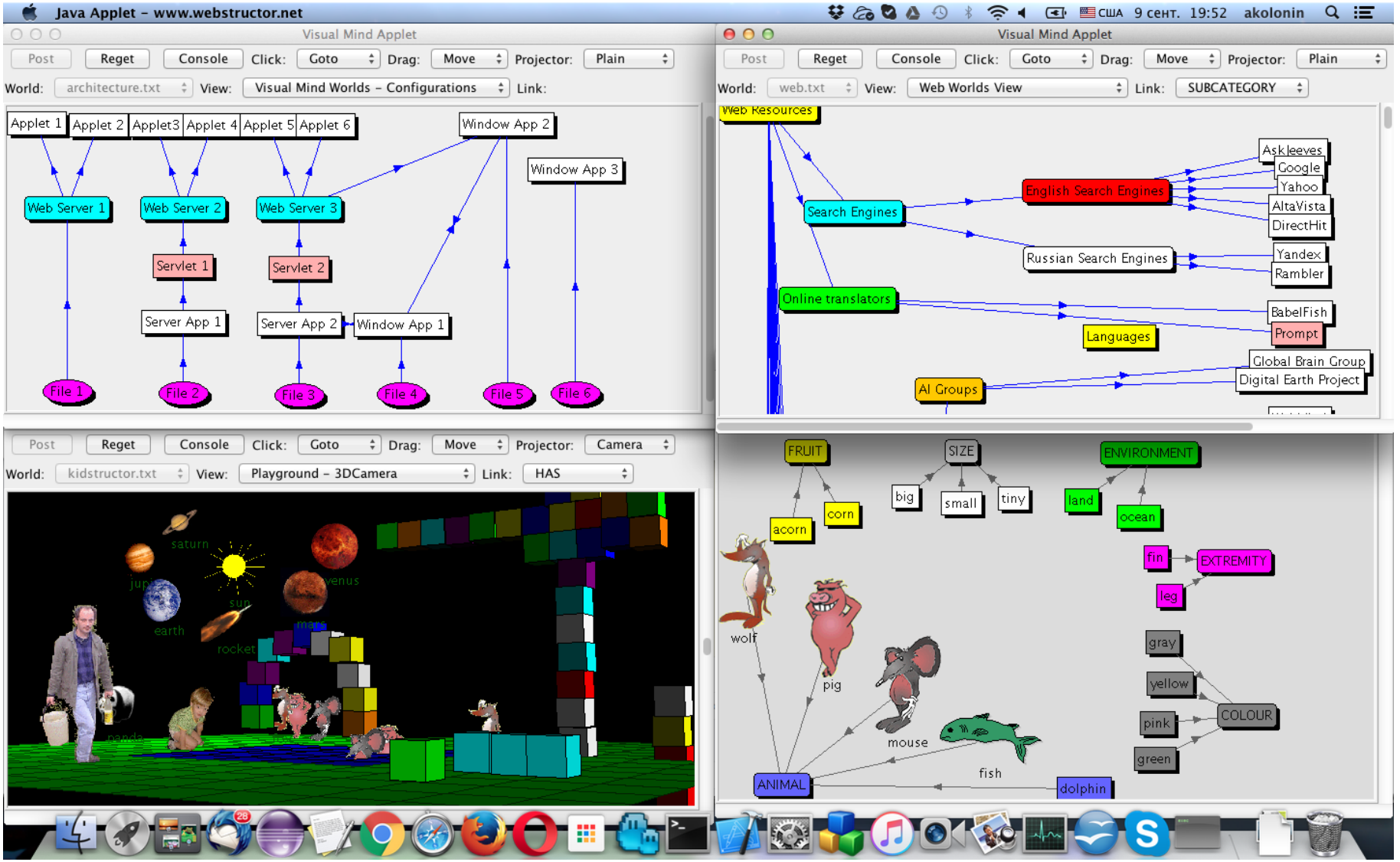
Webstructor: Distributed 2D/3D Editor



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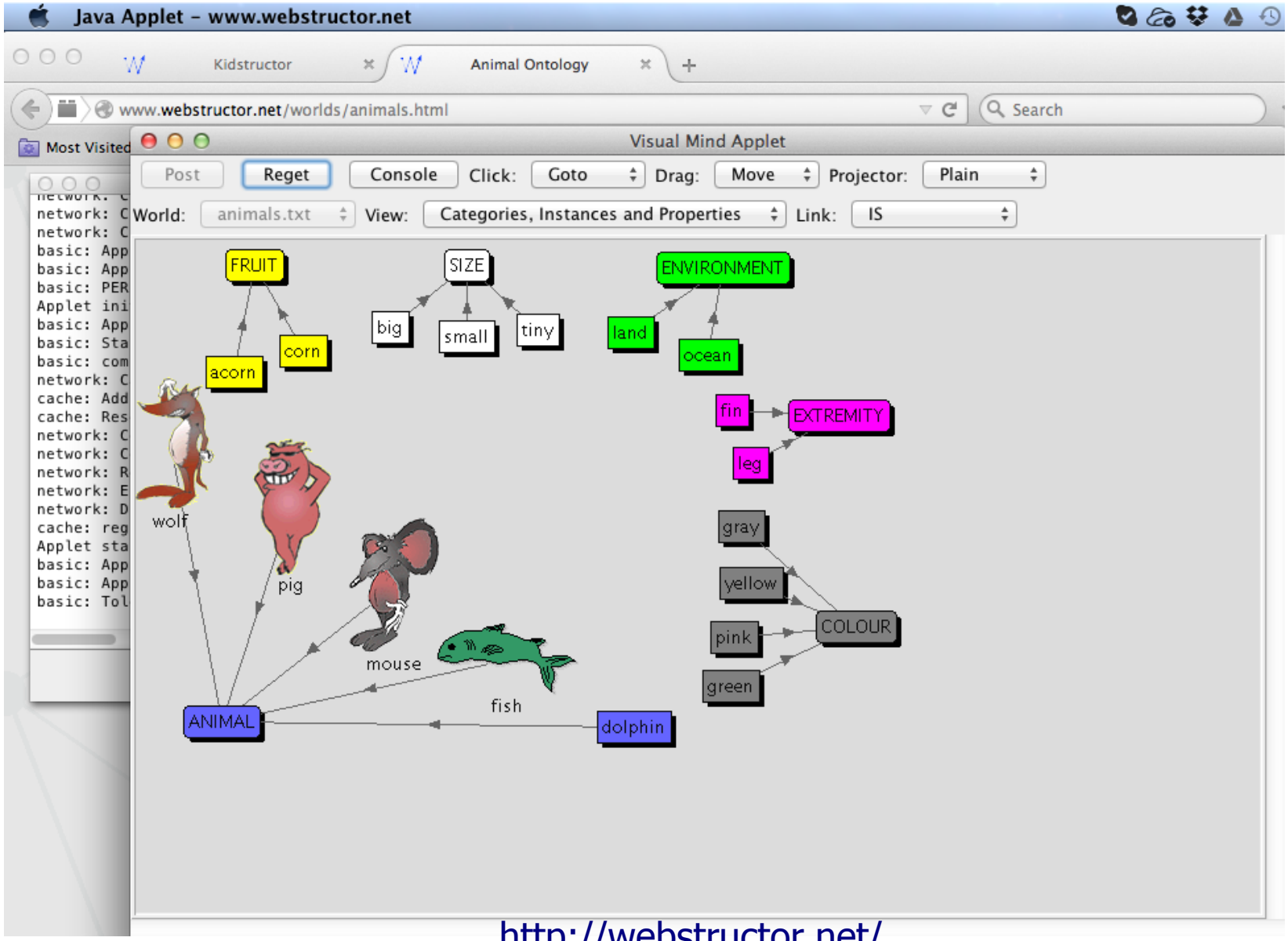
Webstructor: 2D Knowledge Editor Online



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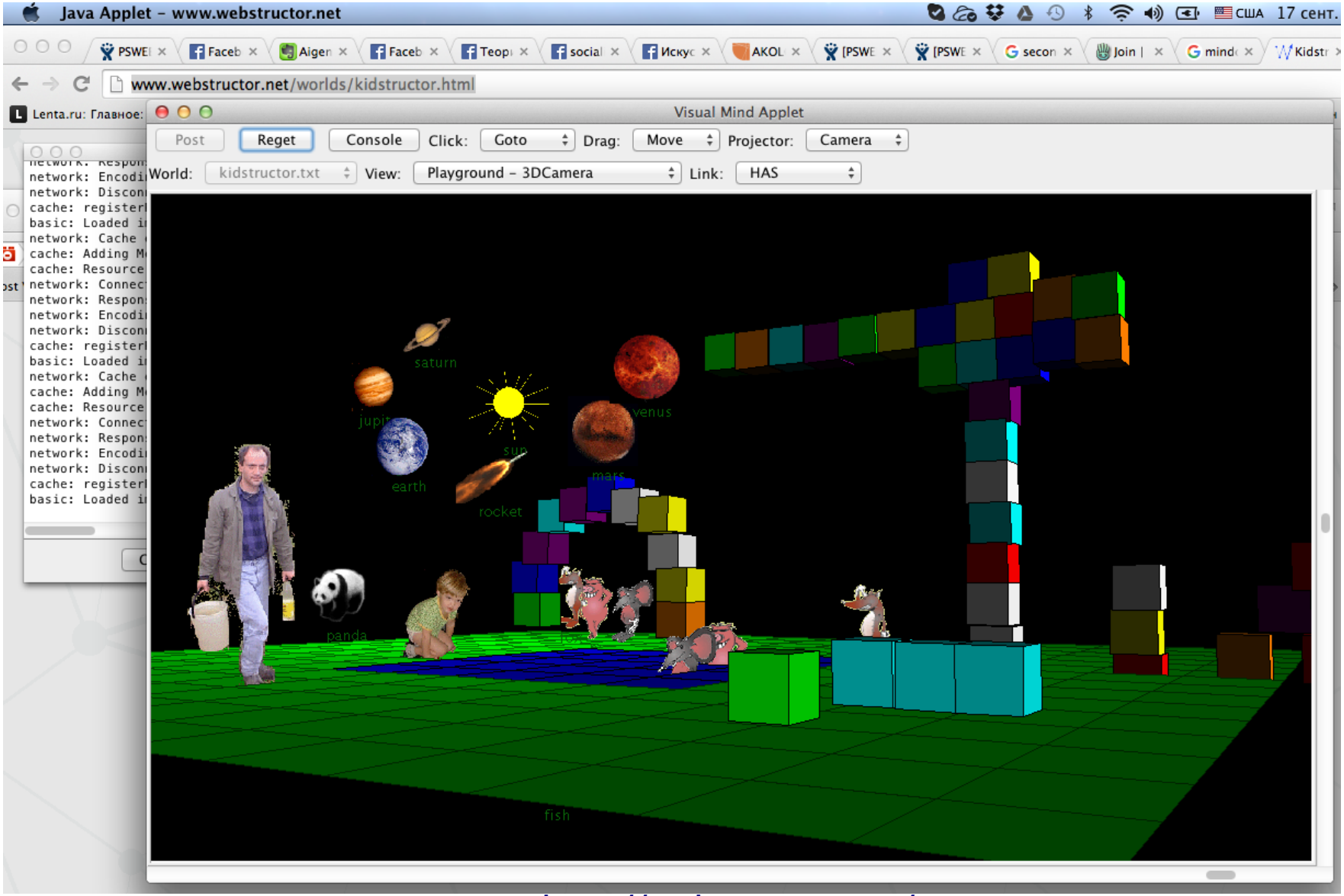
Webstructor: 3D Hyper-World Editor Online



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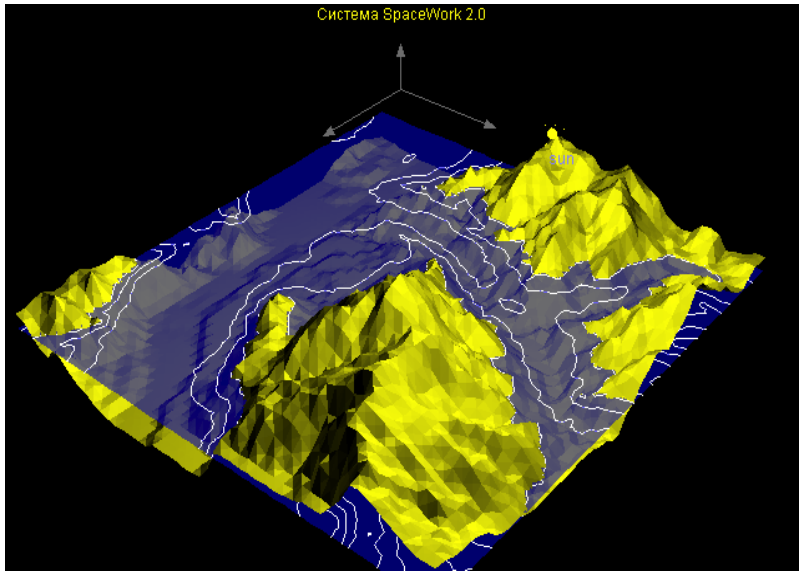
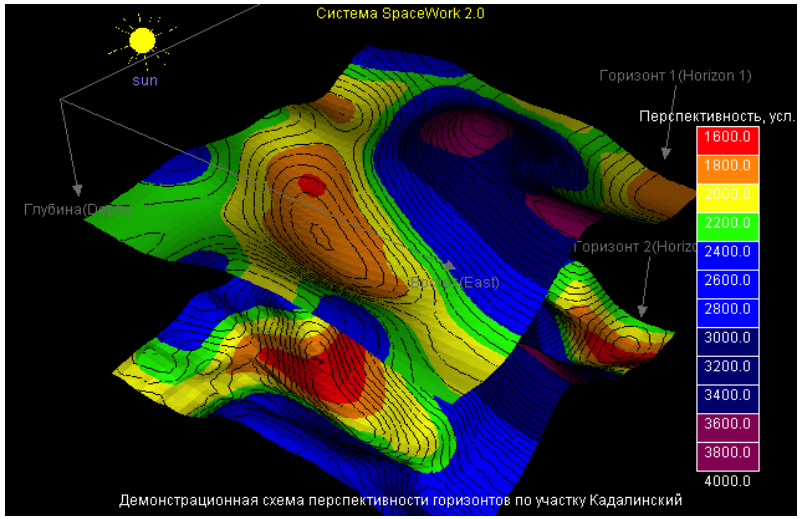
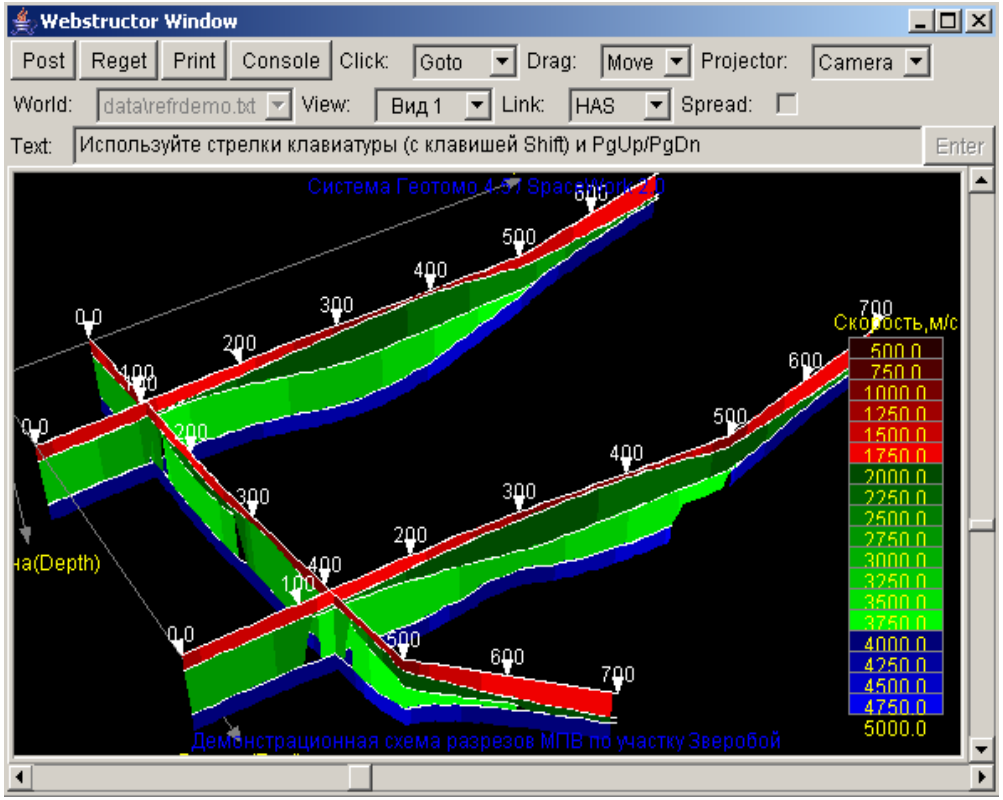
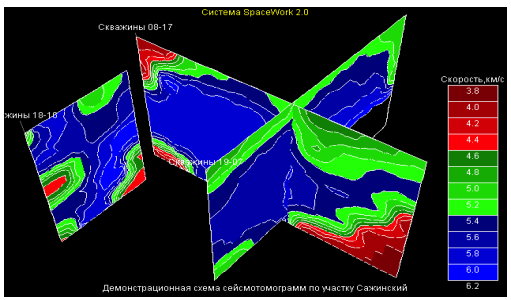
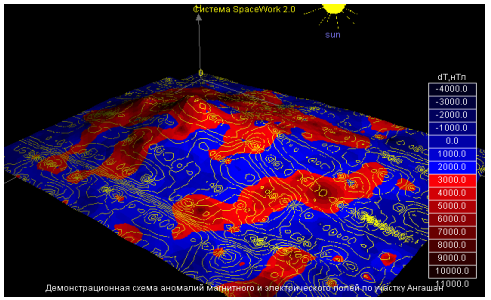
Webstructor: 4D Complex Data Viewer











http://webstructor.net/geotomo/

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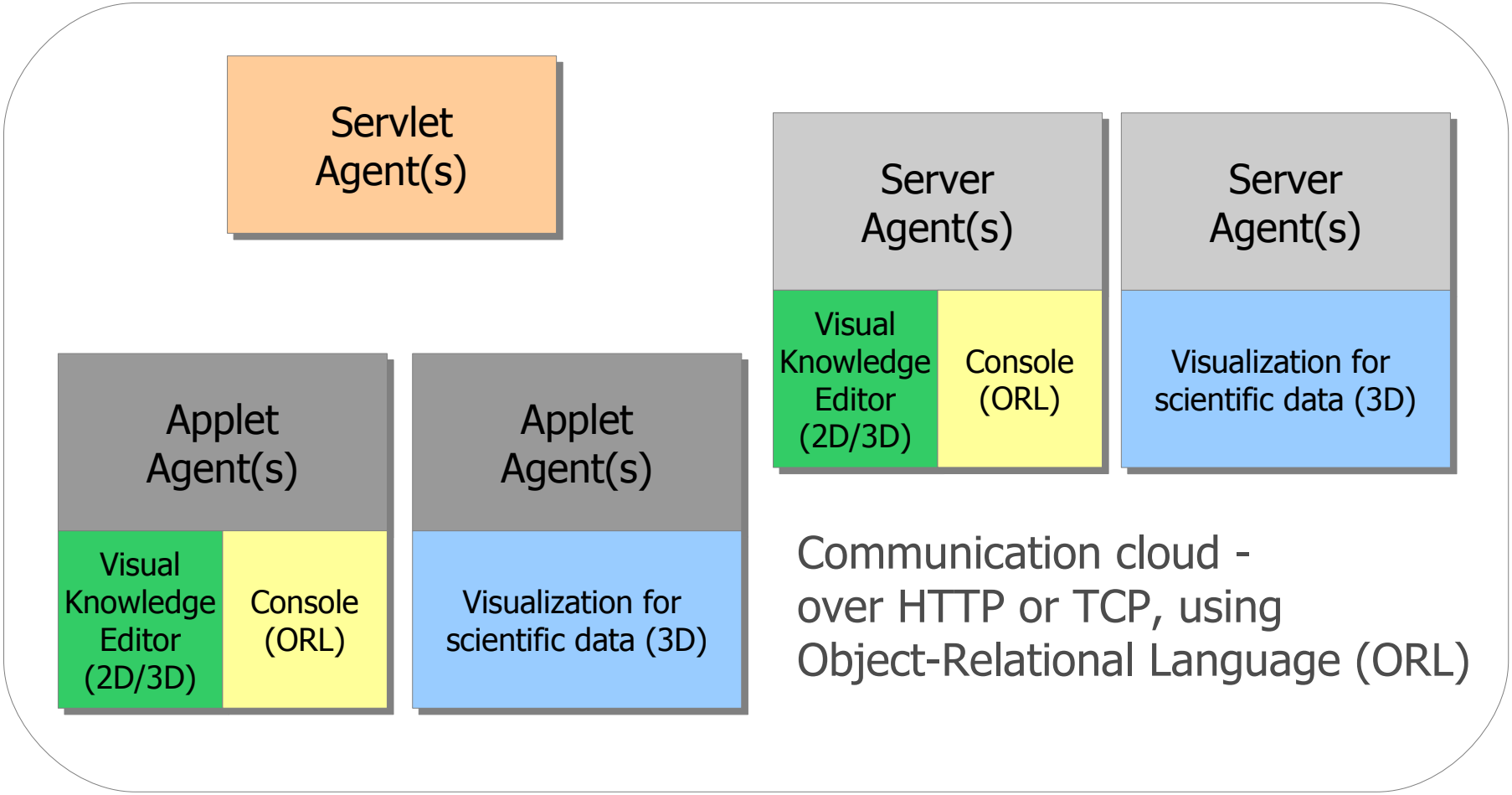
Webstructor: Architecture

Distributed multi-agent (peer-to-peer) architecture



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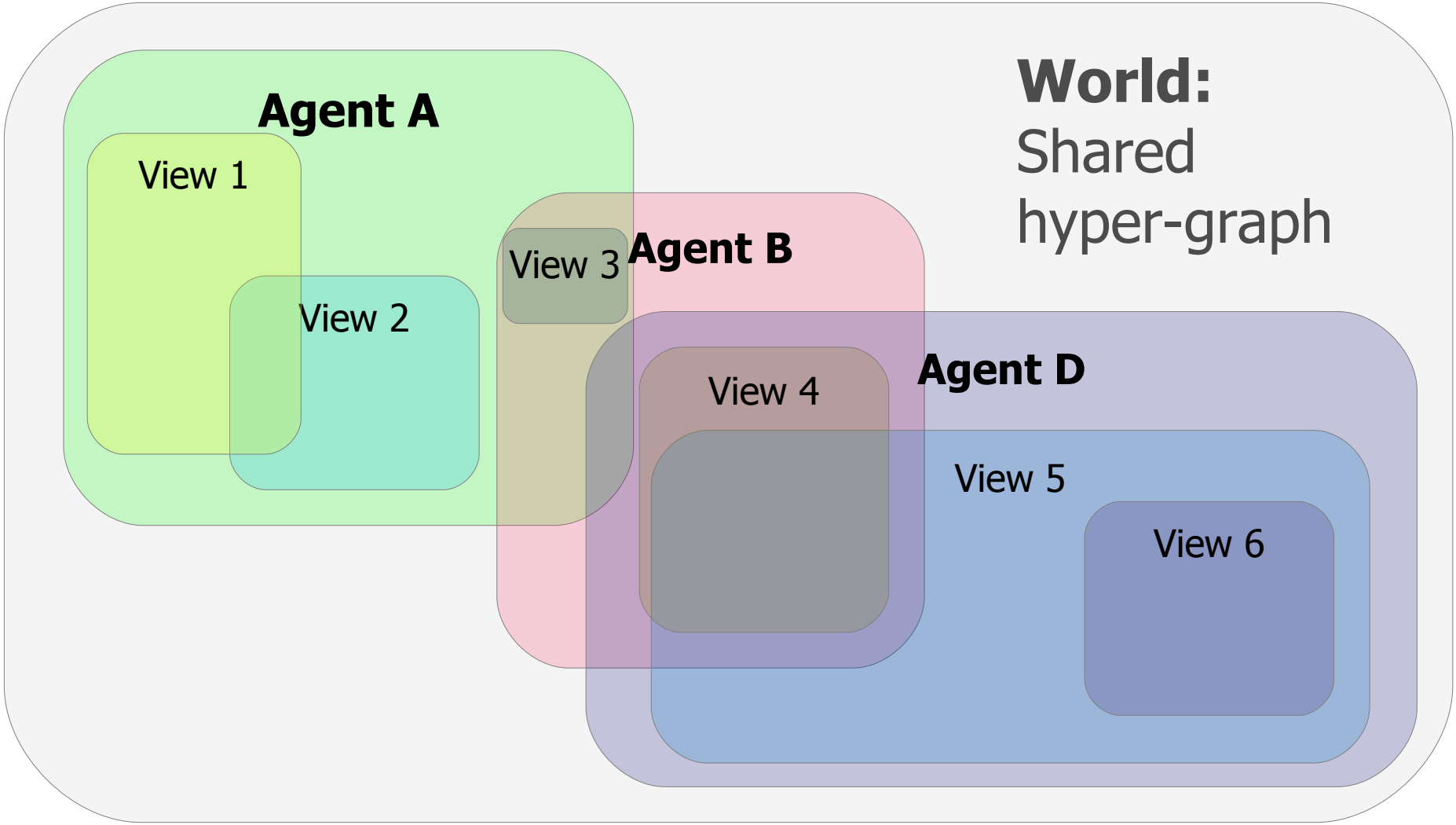
Webstructor: "3D-Net" - Worlds and Views

Webstructor: Sharing "world" data visible in "views"



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Lessons Learned:

1. 2D graphs are fun but not always practical
2. 3D graphs are even more fun but even more less practical
3. Distributed removal of knowledge (and its truth assessment) needs account for evidence and social reference

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Aigents® Language for Distributed Personal AI Agents

Monitoring content and social dynamics in online networks

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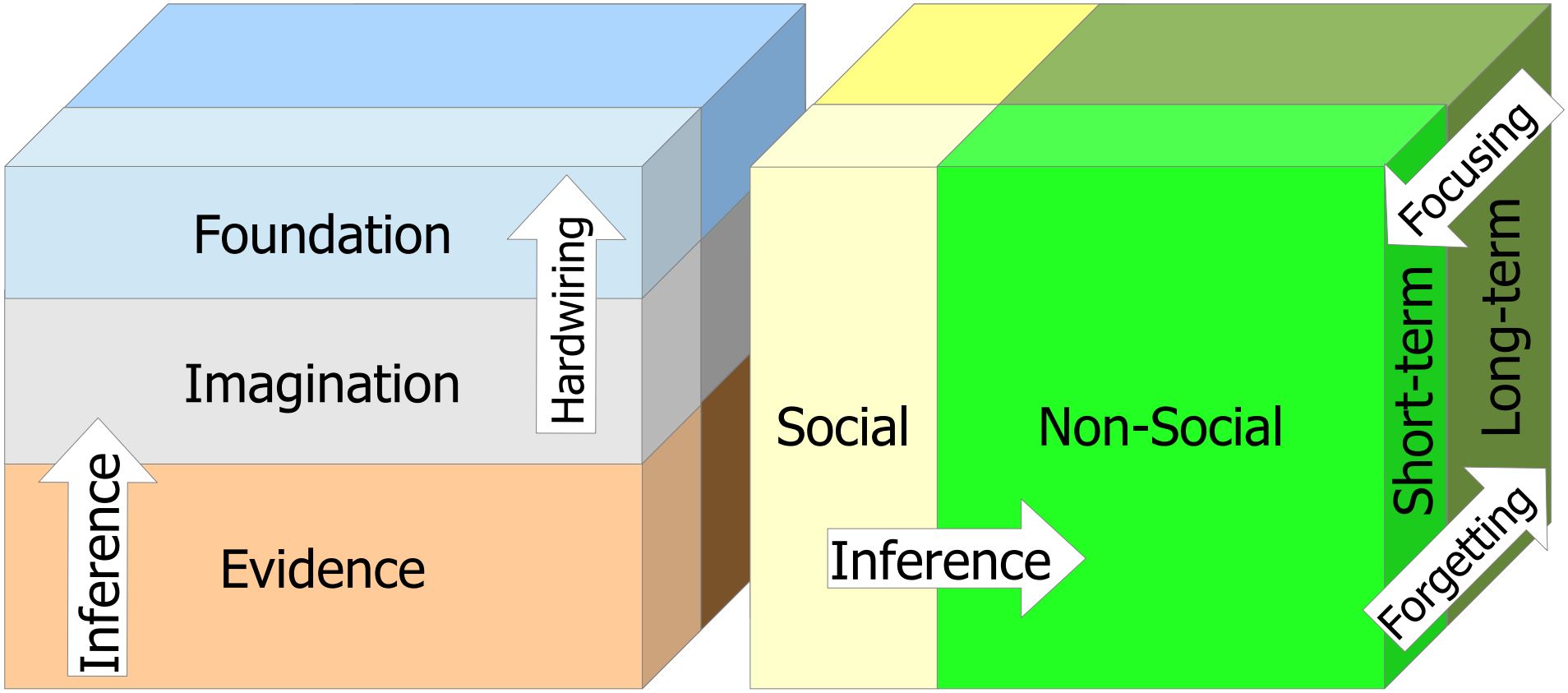
Social-Evidence based Knowledge Representation Model



Top layer - “foundation graph” of basic knowledge, which is necessary for social system to be shared by all of its members in order to communicate.
Middle layer - “imagination graph” keeping “inferred” knowledge.
Bottom layer - “evidence graph” containing everyday life-time experiences.

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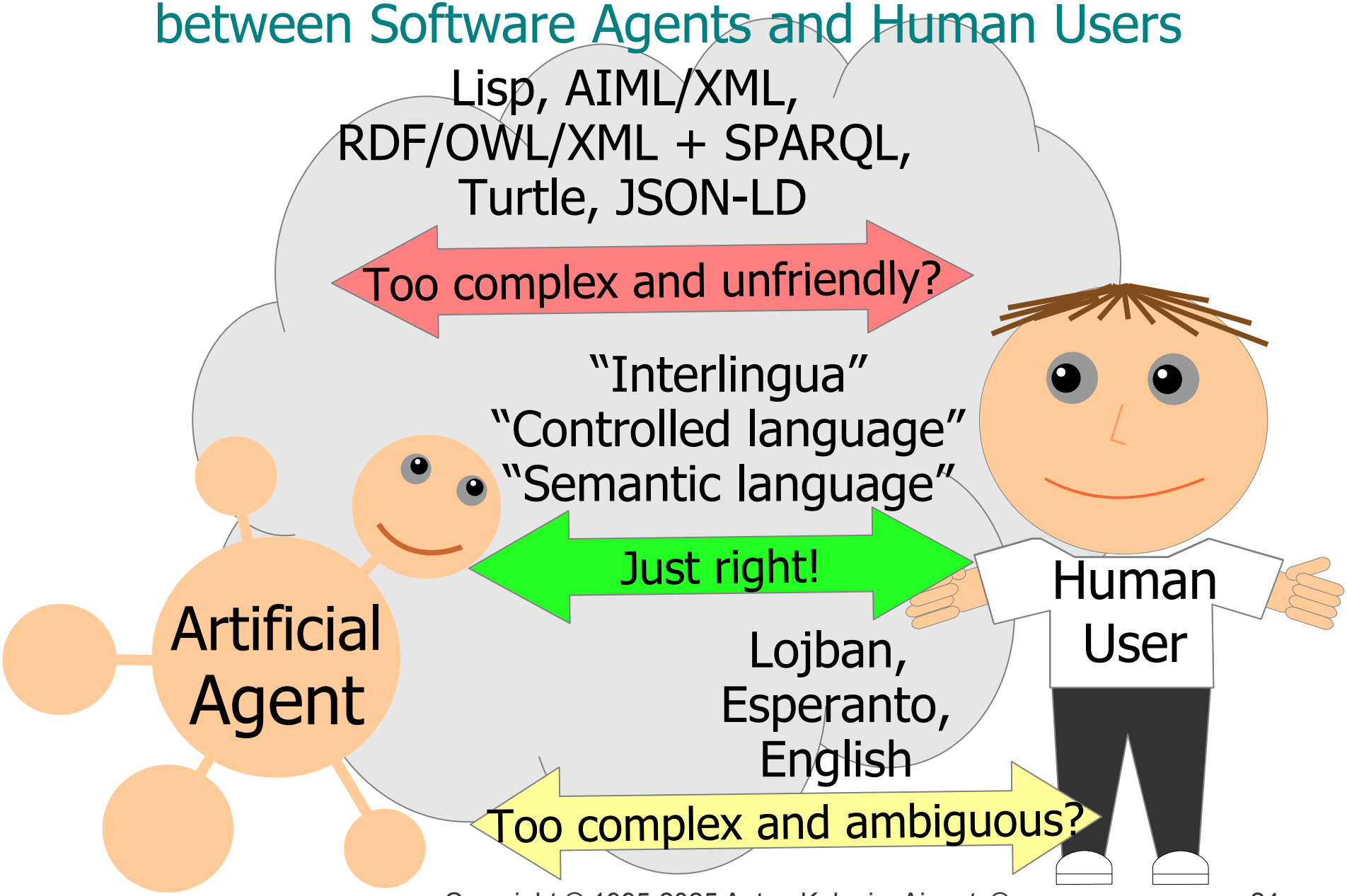
Using "Semantic Language" for Knowledge Transfer between Software Agents and Human Users



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Agent Language (AL) for Home Automation and Internet-of-Things (IoT) – multilingual example

A: My is appliance, agent, thermostat, device.
A: My has shape, color, voltage.
A: My has location.
A: My shape rectangular, color white, voltage 220, location kitchen.
A: My has temperature, humidity, CO2, feeling.
A: Temperature, humidity, CO2 is number.
A: Feeling is good or bad.
H: What your feeling, temperature, humidity?
A: My feeling good, temperature 20, humidity 72.

A: Моя это прибор, агент, термостат, устройство.
A: Моя иметь форма, цвет, питание.
A: Моя иметь место.
A: Моя форма прямоугольный, цвет белый, питание 220, место кухня.
A: Моя иметь температура, влажность, CO2, самочувствие.
A: Температура, влажность, CO2 это число.
A: Самочувствие это хорошо или плохо.
H: Как твоя самочувствие, температура, влажность?
A: Моя самочувствие хорошо, температура 20, влажность 72.

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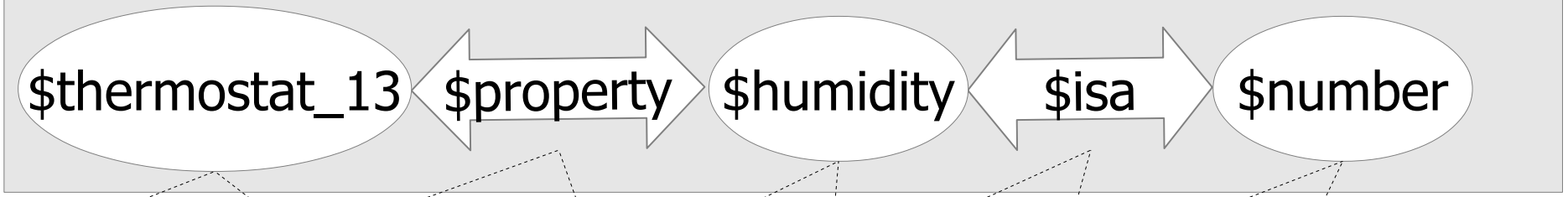
Agent Language (AL) as a "Labeled Turtle"

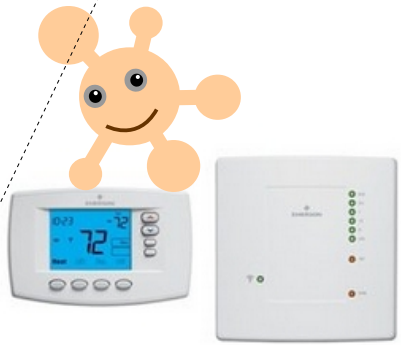
Common domain-specific ontology for "controlled interlingua"



моя
иметь
влажность
это
число

Russian name space

$name



my
has
humidity
is
number

English name space

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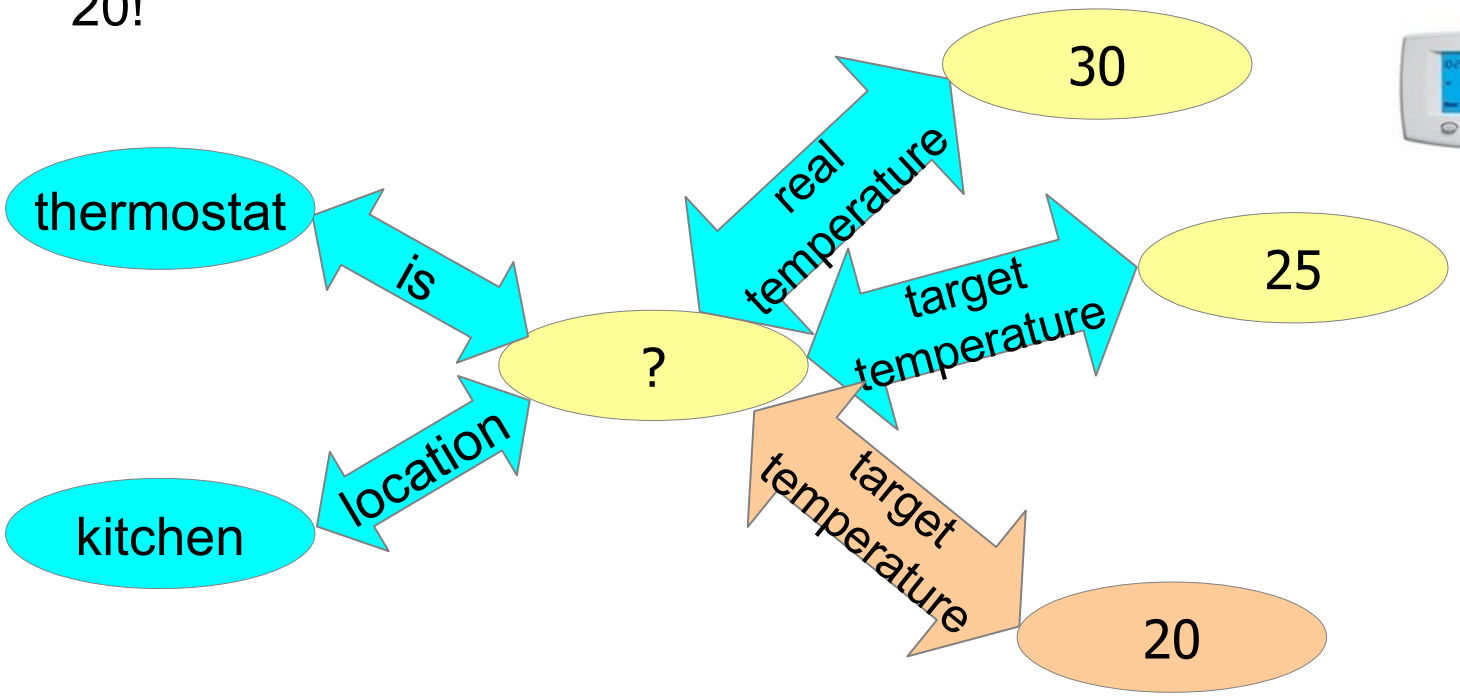
Agent Language (AL) as a Graph Manipulation

Interrogation:
What is thermostat, location kitchen real temperature, target temperature?

Declaration:
Is thermostat, location kitchen real temperature 30, target temperature 25.

Direction:
Is thermostat, location kitchen target temperature 20!



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Agent Language - EBNF

```
<message> := ( <statement> | <acknowledgement> )*
<acknowledgement> := ( 'ok' | ('true' | 'yes' | <number>) | ('no' | 'false' | 0) ) '.'
<statement> := <interrogation> | <confirmation> | <declaration> | <direction>
<interrogation> := 'what' ? <expression> '?'                    (* "open" incomplete graph *)
<confirmation> := 'if' ? <expression-set> '?'                   (* "closed" complete graph  *)
<declaration> := ( <expression-set> ) '.'                       (* "closed" complete graph *)
<direction> := 'do' ? <expression-set> '!'                      (* "closed" complete graph *)
<expression> := <term> (' ' <term>)*                            (* separated by spaces *)
<expression-set> := <all-set> | <any-set> | <seq-set>           (* different kinds of sets *)
<term> := <negation>? ( <anonymous>? | <self> | <peer> | <id> | <name> | <value> | <qualifier> )
<qualifier> := <expression> | <expression-set>
<any-set> := <or-list> | ( '{' <or-list> '}' )
<all-set> := <and-list> | ( '(' <and-list>  ')' )
<seq-set> := <next-list> | ( '[' <next-list> ']' )
<or-list> := <expression> ( (',' | 'or' ) <expression> )*
<and-list> := <expression> ( (',' | 'and' ) <expression> )*
<then-list> := <expression> ( (',' | 'next' ) <expression> )*
<negation> := 'not' | 'no' | '~'
<anonymous> := ('there' ('is'|'are')) | 'any' | 'anything' ?
<self> := 'my'|'i'|'we'|'our'
<peer> := 'your'|'you'
<value> := <number> | <date> | <time> | <string>
```

That is all!
There rest is done by means of domain-specific ontology and providing national-specific name space

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Agent Language - comparisons

English
What is your feeling?
If your feeling is good?
Your feeling is good.
Have your feeling good!

Agent Language
Your feeling?
Your feeling good?
Your feeling good.
Your feeling good!

Russian (with tonal modulation)
Твое ощущение? (rising tone)
Твое ощущение хорошее? (rising tone)
Твое ощущение хорошее. (neutral tone)
Твое ощущение хорошее! (lowering tone)

Agent Language - written	**Agent Language - spoken**
I (can (eat, sleep), want (dance, sing)).	I can eat and sleep and want dance and sing.
I {can (eat, sleep), want (dance, sing)}.	I can eat and sleep or want dance and sing.
I (can {eat, sleep}, want {dance, sing}).	I can eat or sleep and want dance or sing.
You [eat (rice, meat), drink {tea, beer}]!	You eat rice and meat next drink tea or beer!

Agent Language
A C (D,E).
A (C D, F G).
A (C (D,E), F (G,H)).
(A,B) C D.
(A,B) (C (D,E), F (G,H)).

Term logic
A C D. A C E.
A C D. A F G.
A C D. A C E. A F G. A F H.
A C D. B C D.
A C D. A C E. B C D. B C E. A F G. A F H. B F G. B F H.

Turtle
A C D,E.
A C D; F G.
A C D,E; F G,H.

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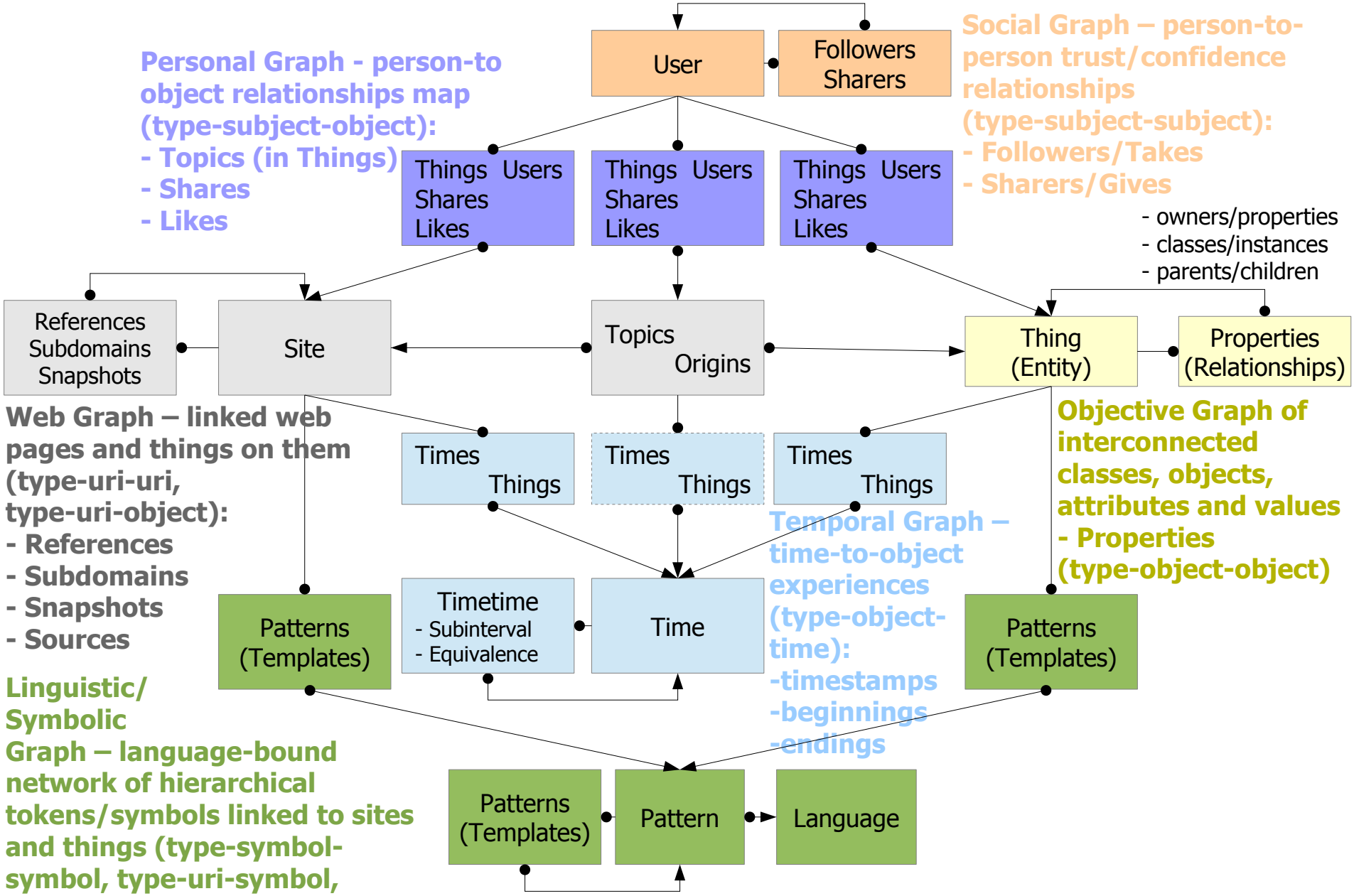
Aigents® Upper Ontology for Online Media Monitoring & Studies



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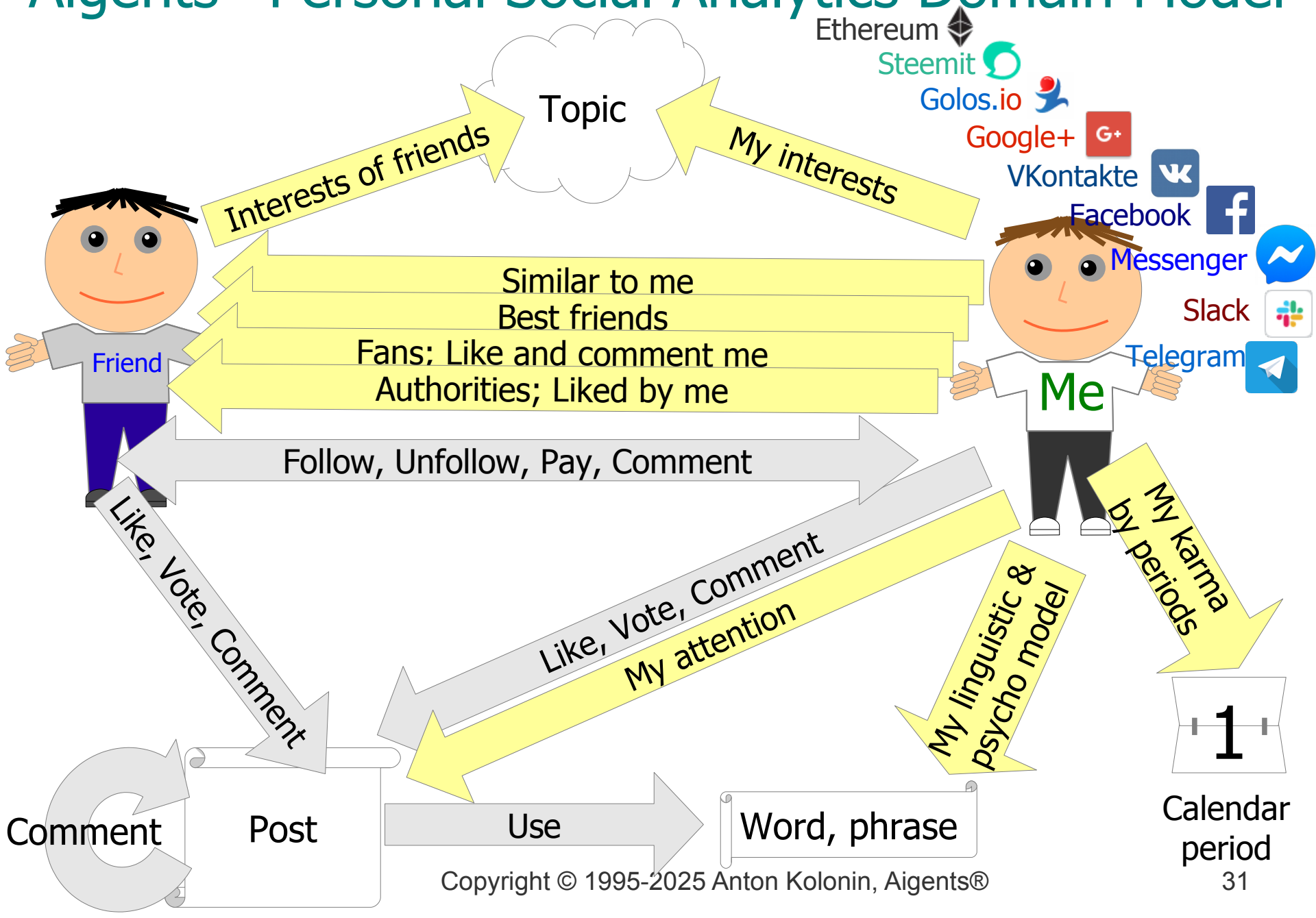
Aigents® Personal Social Analytics Domain Model



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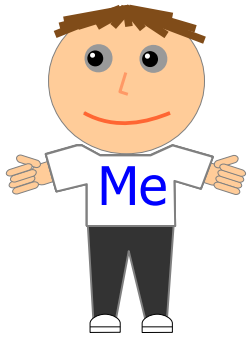
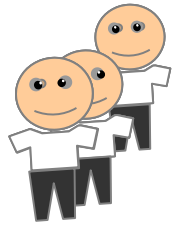
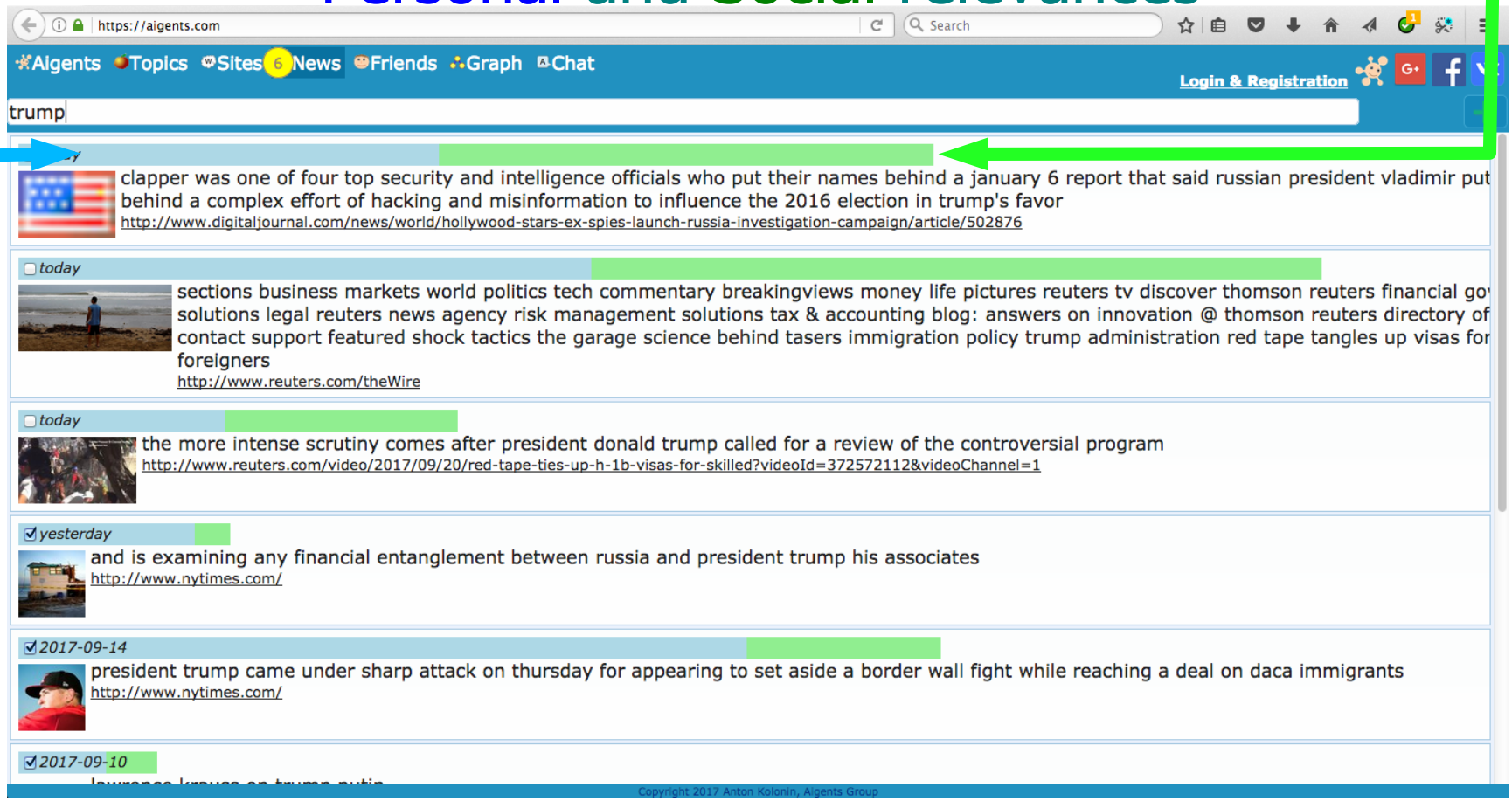


Case 1: Collaborative News Filtering: Monitoring web pages and extracting textual information with account to Personal and Social relevances





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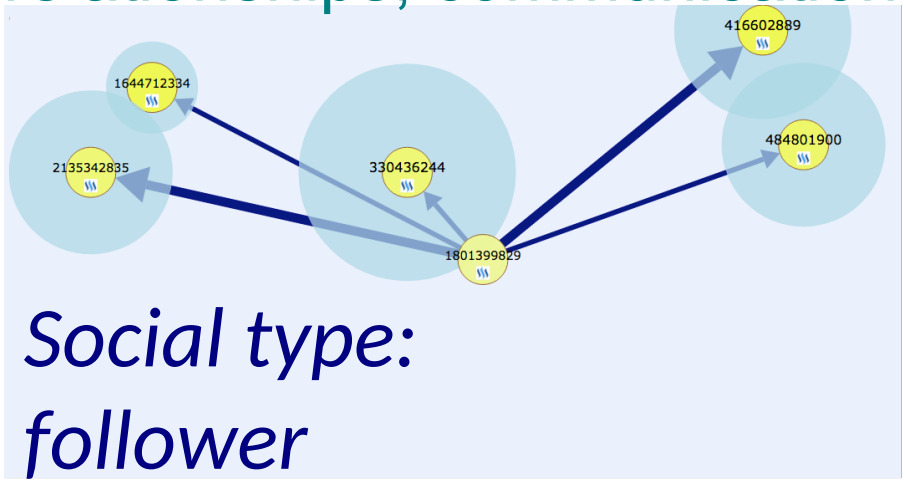
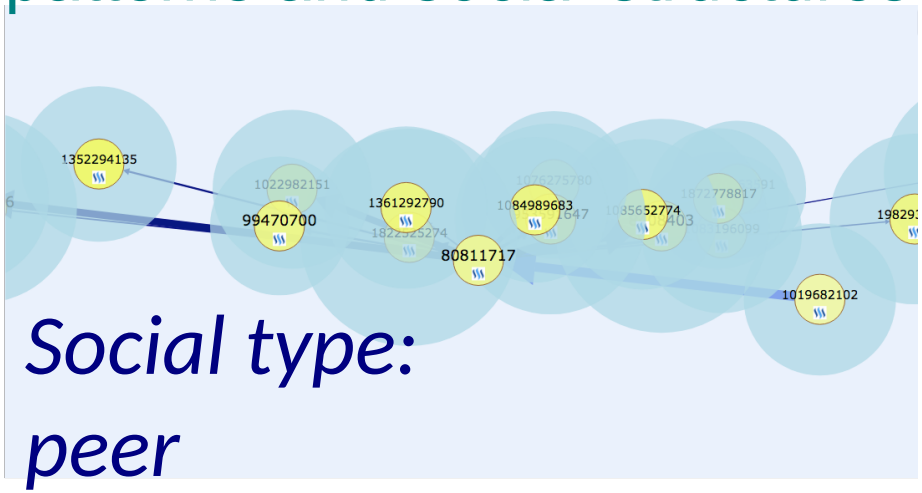
Case 2: Helping users to understand themselves better and perform more efficiently online – using their tracks in social networks and online resources, capture their interests, relationships, communication patterns and social structures.

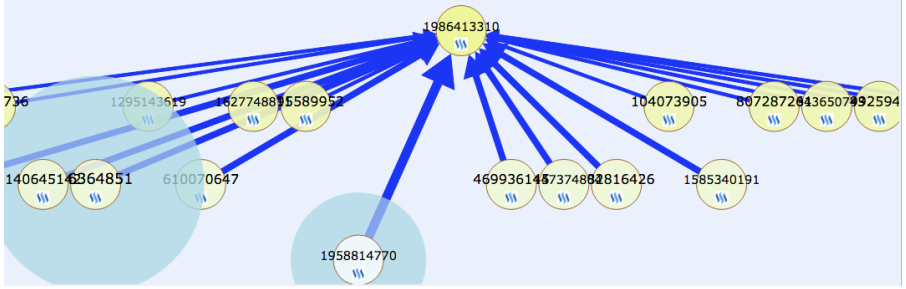


Social type: follower

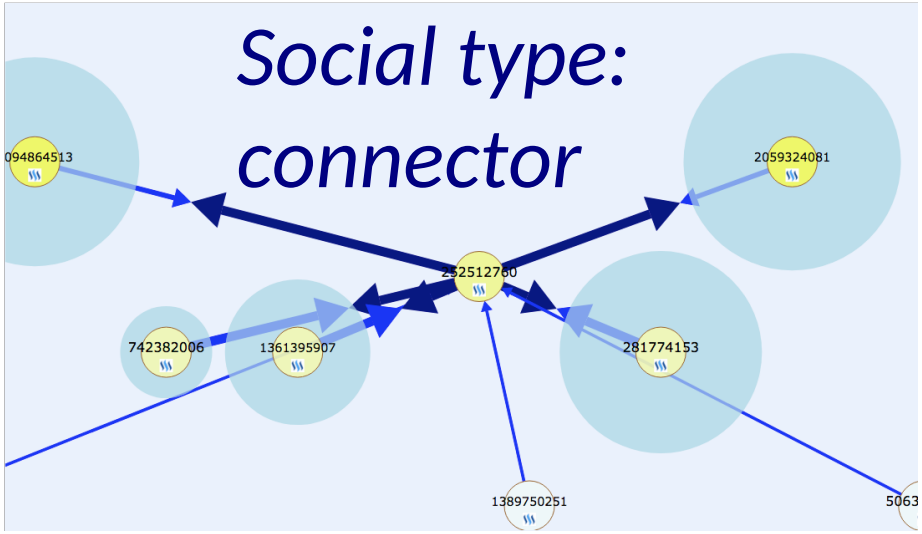


Social type: peer

Social type: opinion leader



Social type: connector



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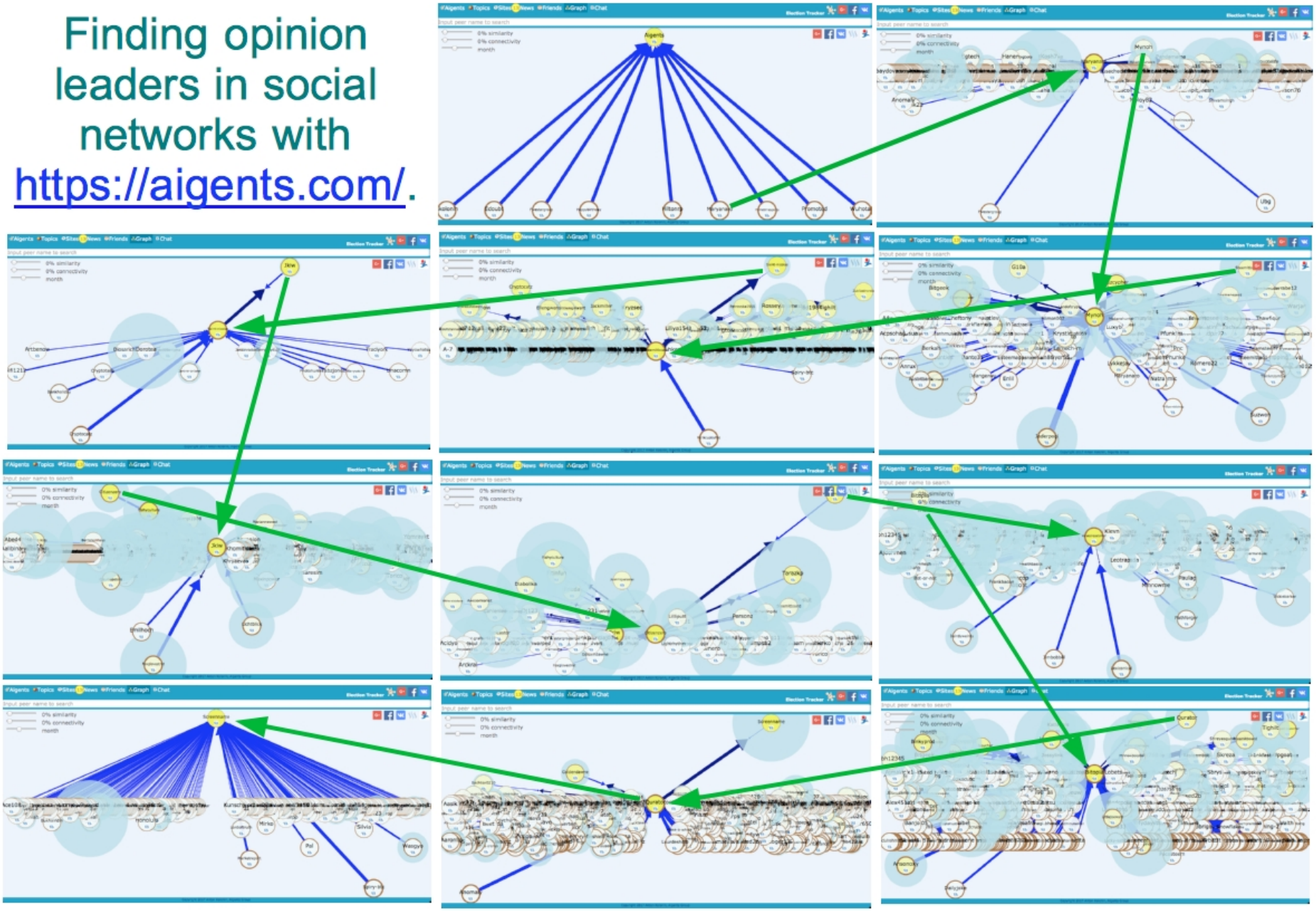
Case 3:

Finding opinion leaders in social networks with https://aigents.com/.



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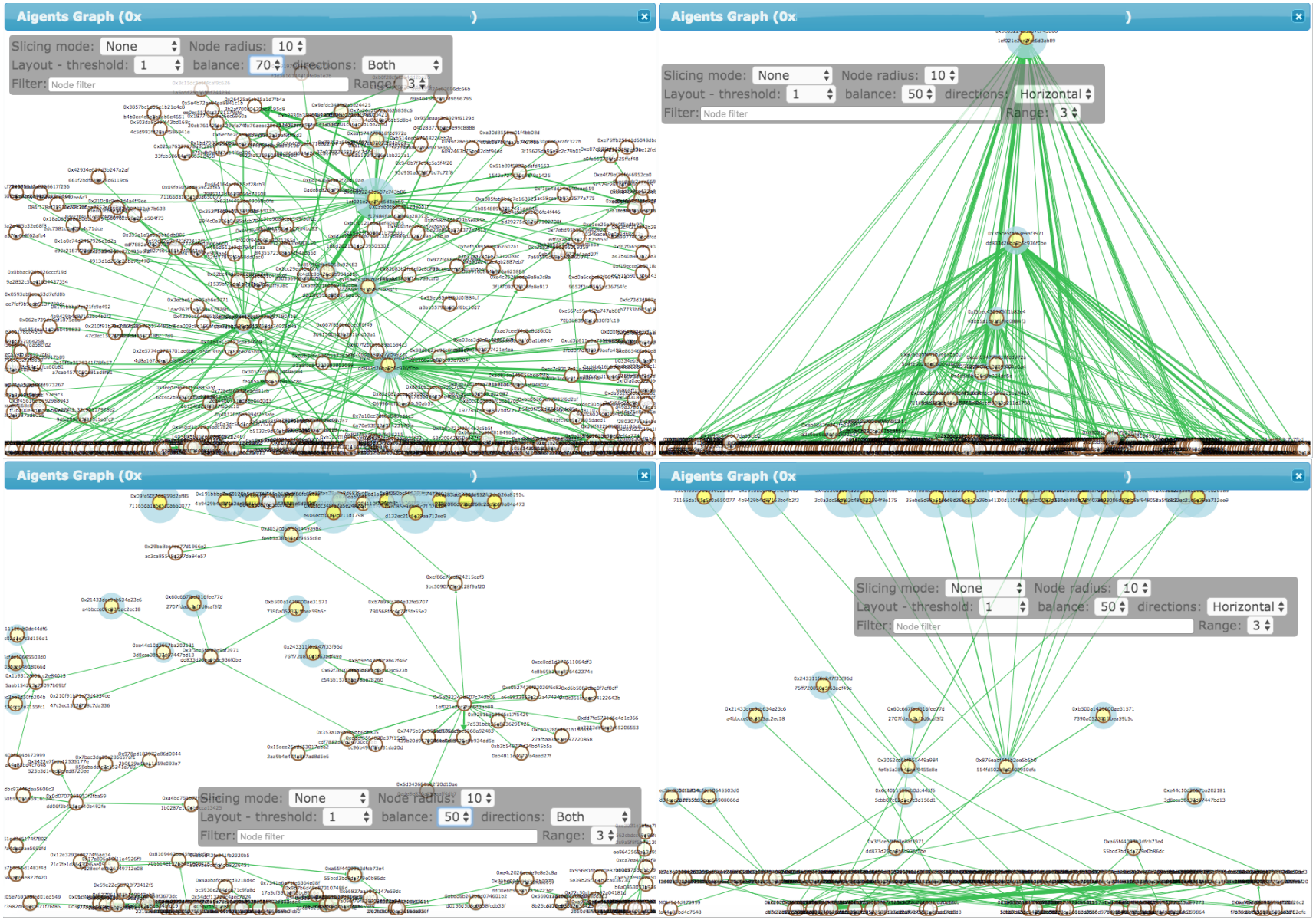
Aigents®: Ethereum cash flow graph study



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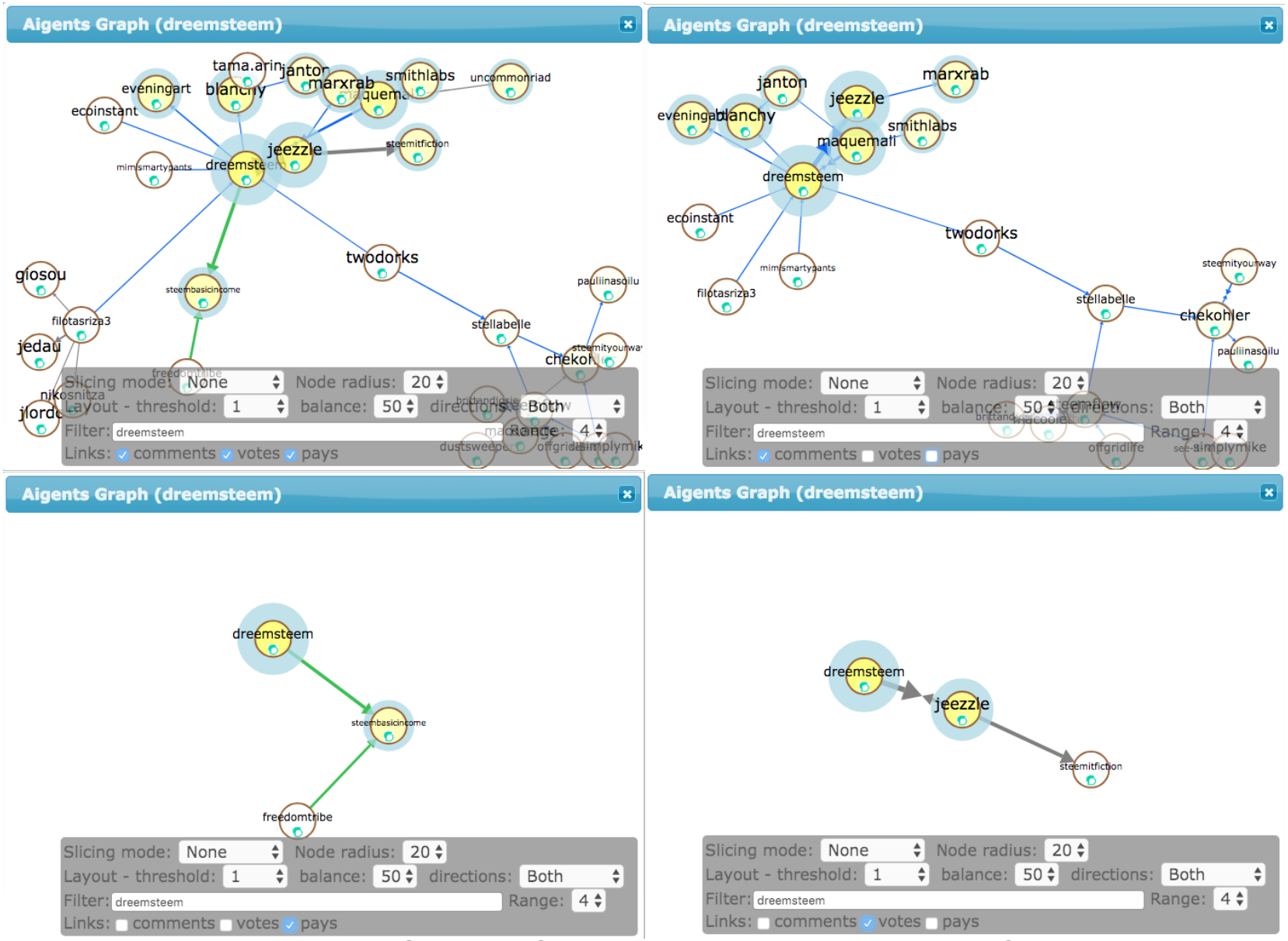
Aigents®: Steemit social network graph study



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Lessons Learned:

1. People and users don’t like to learn new languages (including controlled, pidgin and graphical)
2. They like to use their own language or usable GUI-s
3. **Selling is hard :-)**

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Foundation Ontology

No-ontology
Cyc Knowledge Base
Freebase/Google Knowledge Graph
OpenCog Atomspace
Webstructor/Aigents®
Custom Domain

Graph Storage

Any RDBMS + time & triple indexing
Any "Triple Store" + time indexing
TimeScale DB + triple indexing
OpenCog AtomSpace
Aigents® Temporal Graphs

Semantic Language

RDF/OWL/Turtle/JSON-LD/SparQL
CycL – Cyc Language (D.Lenat)
ORL (A.Kolonin, L.Kuzin)
D0SL (V.Gumirov, D.Sviridenko)
OpenCog Atomese (B.Goertzel)
Narsese (P.Wang, P.Hammer)
AL – Aigents® Language (A.Kolonin)
Premise (M.Miller)

Inference Engine

Non-Axiomatic Reasoning System – NARS (P.Wang, et. al.)
Logical Prediction System – "Discovery" (E.Vityaev et.al.)
OpenCog Probabilistic Logic Network – PLN (B. Goertzel et. al.)

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What is all you need?

	Inference Engine	**Semantic Language**	**Graph Database**	**Foundation Ontology**	**License**
OpenCog	Unified Rule Engine (URE)/ Probabilistic Logic Network (PLN)	Atomese	AtomSpace	AtomSpace Atom Types	GPL
Non-Axiomatic Reasoning System (NARS)	Non-Axiomatic Reasoning System (NARS)	Narsese	Internal In-memory	Ontology-agnostic?	MIT
Discovery + D0SL	Discovery	D0SL	Internal in-memory	D0SL	GPL + Commercial
Webstructor/ Aigents®	*TBD*	ORL, AL	Aigents Graphs	Aigents	MIT

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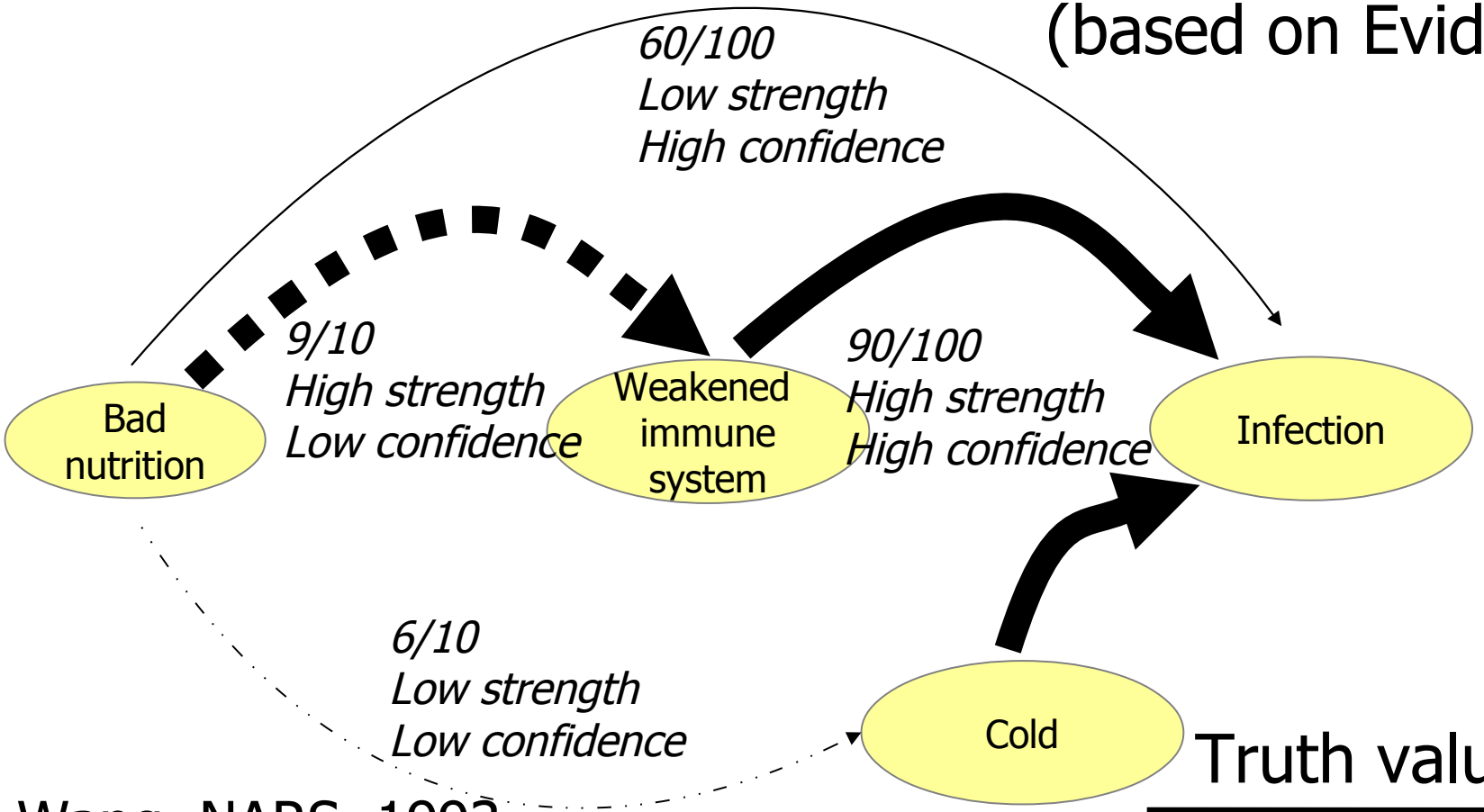
Complex Truth Values for Probabilistic Logic

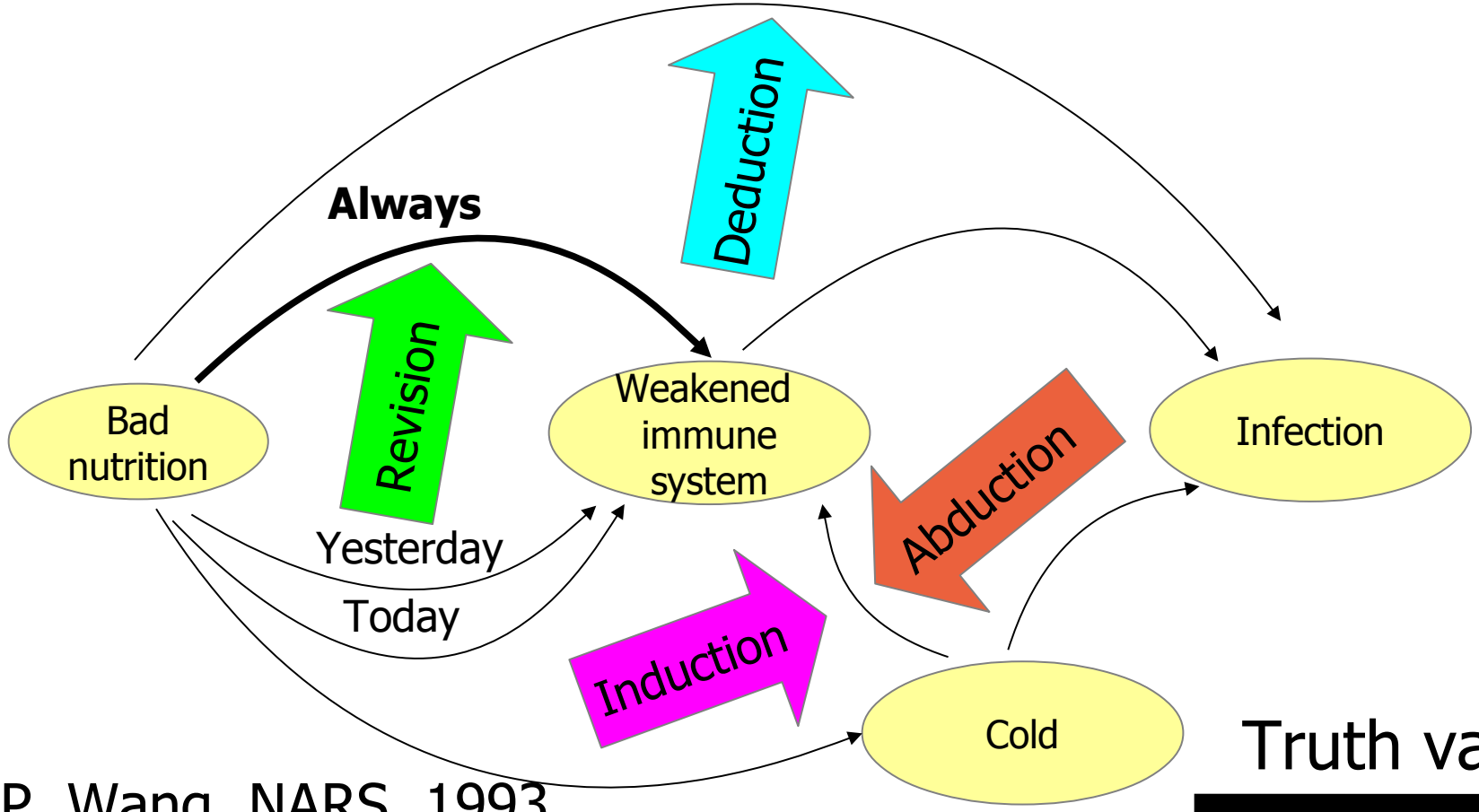
Probabilistic Logic: Separating Strength and Confidence (based on Evidence)



P. Wang, NARS, 1993
E. Vityaev, Discovery, 2001
B. Goertzel et al., PLN, 2008

Complex Truth Values for Probabilistic Logic

Example: Non-Axiomatic Reasoning System (NARS)

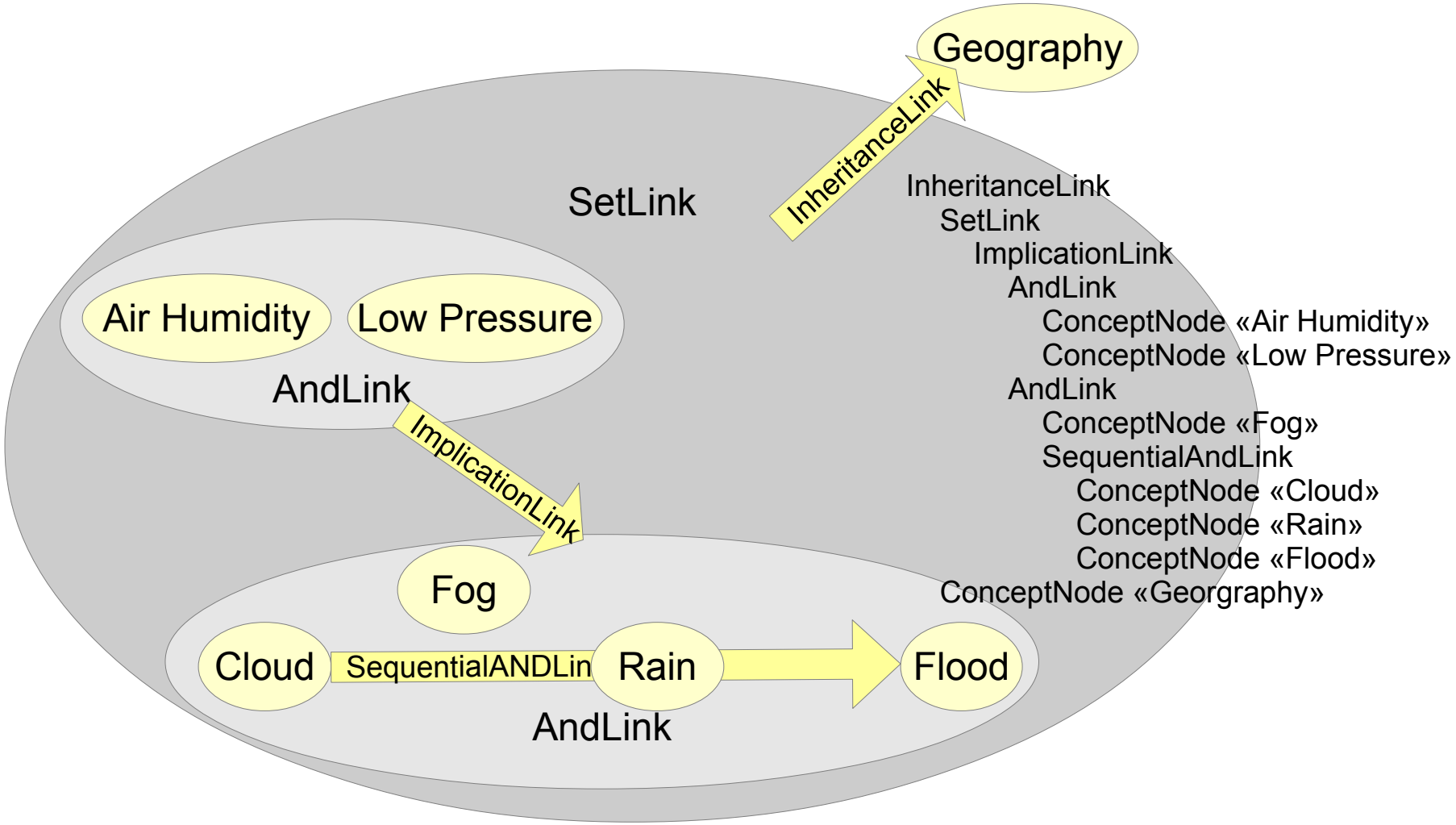


P. Wang, NARS, 1993
E. Vityaev, Discovery, 2001
B. Goertzel et al., PLN, 2008

Truth value:

Strength, Confidence

AtomSpace - Generalized (Link-as-Node) Hyper-Graph is a Meta-Graph (in Atomese)



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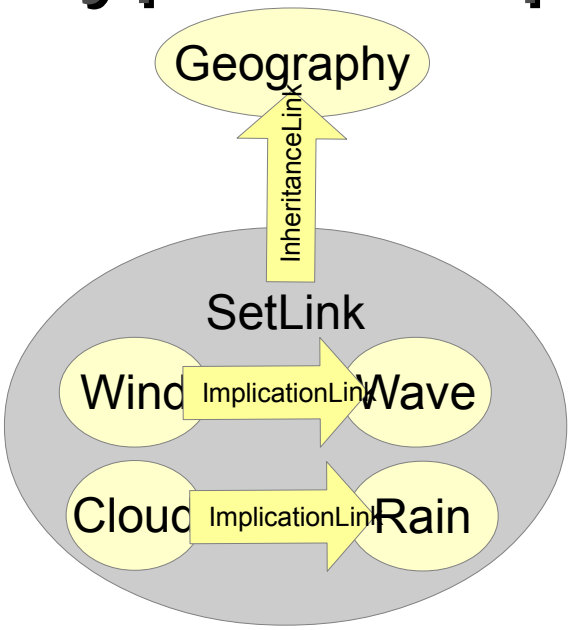
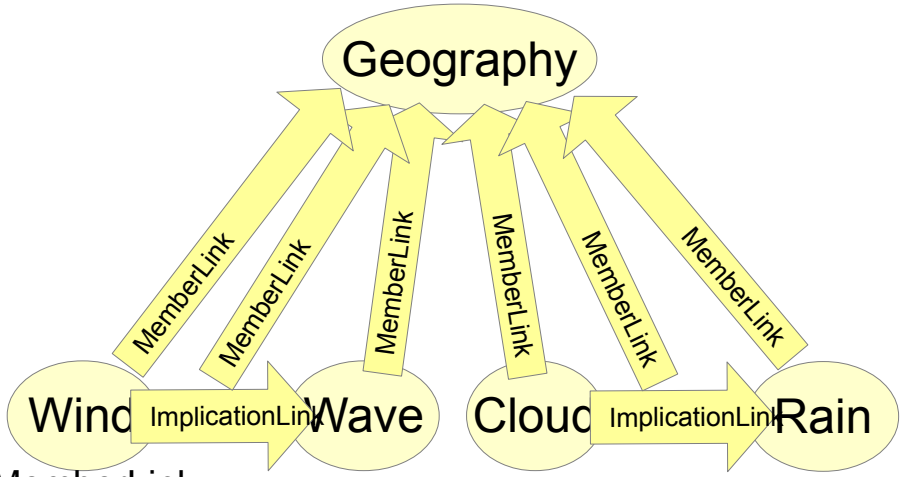
AtomSpace - Meta-Graphs with Hyper-Graphs and Links-on-Links



InheritanceLink
  SetLink
    ImplicationLink
      ConceptNode «Wind»
      ConceptNode «Wave»
    ImplicationLink
      ConceptNode «Cloud»
      ConceptNode «Rain»
  ConceptNode «Georgraphy»



MemberLink
  ConceptNode «Wind»
  ConceptNode «Georgraphy»
MemberLink
  ConceptNode «Wave»
  ConceptNode «Georgraphy»

MemberLink
  ImplicationLink
    ConceptNode «Wind»
    ConceptNode «Wave»
  ConceptNode «Georgraphy»

MemberLink
  ConceptNode «Cloud»
  ConceptNode «Georgraphy»
MemberLink
  ConceptNode «Rain»
  ConceptNode «Georgraphy»

MemberLink
  ImplicationLink
    ConceptNode «Cloud»
    ConceptNode «Rain»
  ConceptNode «Georgraphy»

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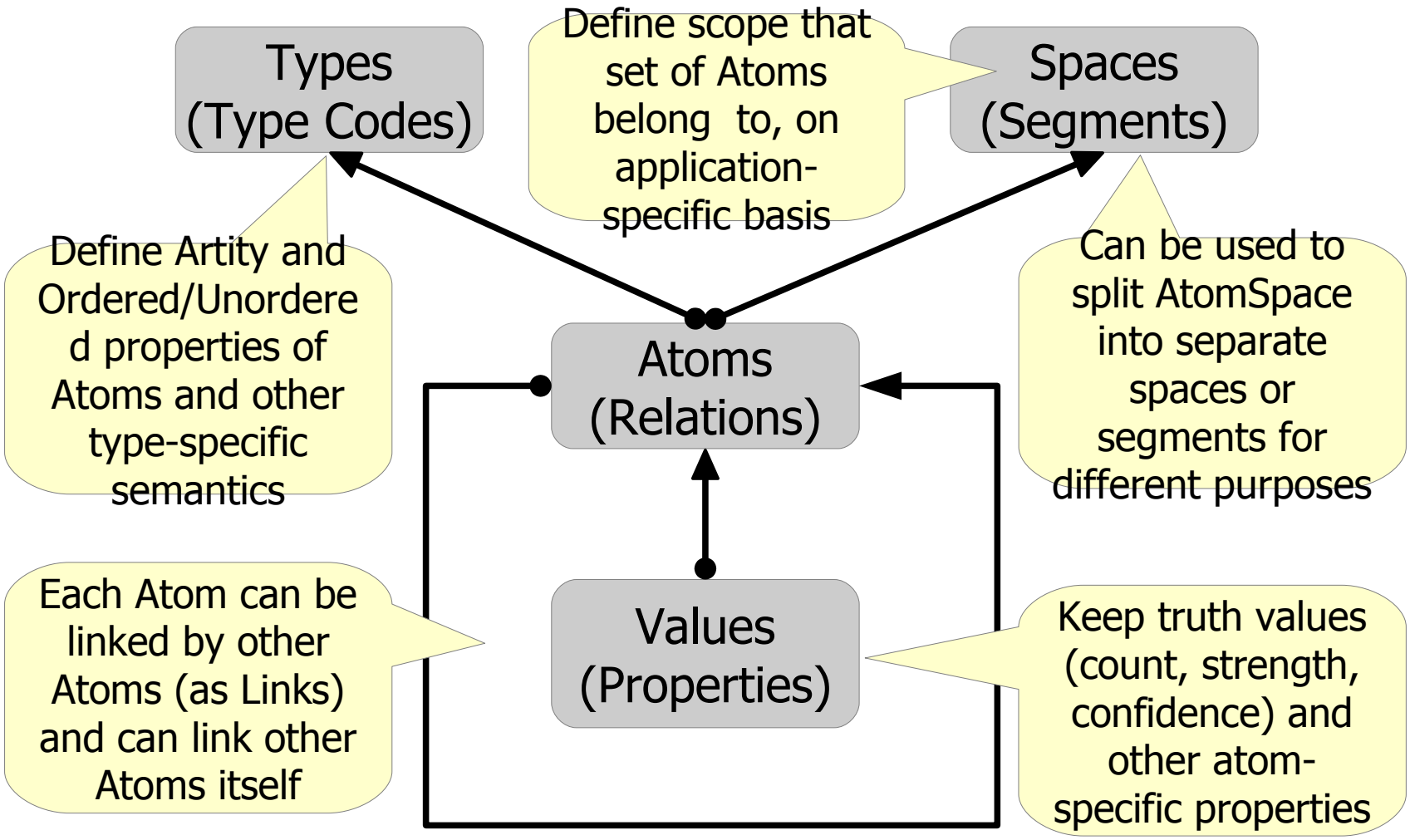
OpenCog AtomSpace, what's inside



https://github.com/opencog/atomspace/blob/master/opencog/atoms/base/atom_types.script

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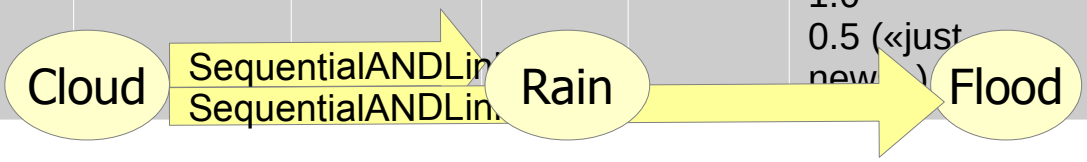
OpenCog Atoms - Inference

Id	Type	Space	Name (Label)	Level in Meta-Graph	Arity	Argu-ments	Truth Value: Count, Strength, Confidence
11	SequentialANDLink	5	-	2	2	13, 14	22 0.5 (22/44=50%) 1.0 («surely»)
12	SequentialANDLink	5	-	2	3	13, 14, 15	11 0.25 (11/44=25%) 0.5 («probably»)
13	ConceptNode	5	«Cloud»	0	0	-	44 1.0 1.0 («fact»)
14	ConceptNode	5	«Rain»	0	0	-	22 1.0 1.0 («fact»)
15	ConceptNode	5	«Flood»	0	0	-	11 1.0 0.5 («just new»)

Atom Type is used to infer if atom is link and if it is Ordered/directed or Unordered/undirected



https://github.com/opencog/atomspace/blob/master/opencog/atoms/base/atom_types.script

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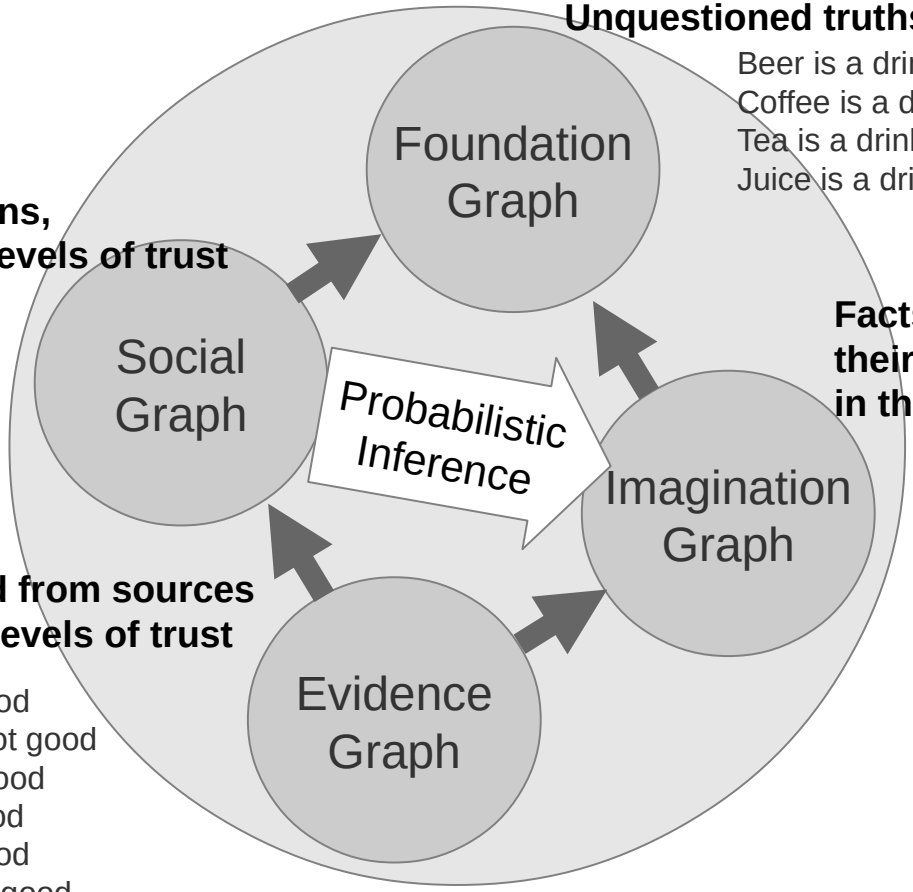
Social evidence-based resource-constrained cognitive-behavioral model



Unquestioned truths and beliefs

Beer is a drink
Coffee is a drink
Tea is a drink
Juice is a drink

Social connections, with account to levels of trust

Mary is my best friend
Peter is best fiend
Bob is Peter's friend

Facts weighed based on their social sources and assessments, in the light of unquestioned beliefs

★★★ I like juice very much
★★ I like tea
★ I may try coffee
I won't try beer

Facts obtained from sources with different levels of trust

Bob said beer is good
Mary said beer is not good
Mary said juice is good
Mary said tea is good
Peter said tea is good
Peter said coffee is good

2015-2018

https://ieeexplore.ieee.org/document/7361869
https://www.sciencedirect.com/science/article/pii/S1877050916317239
https://link.springer.com/chapter/10.1007/978-3-319-97676-1_10

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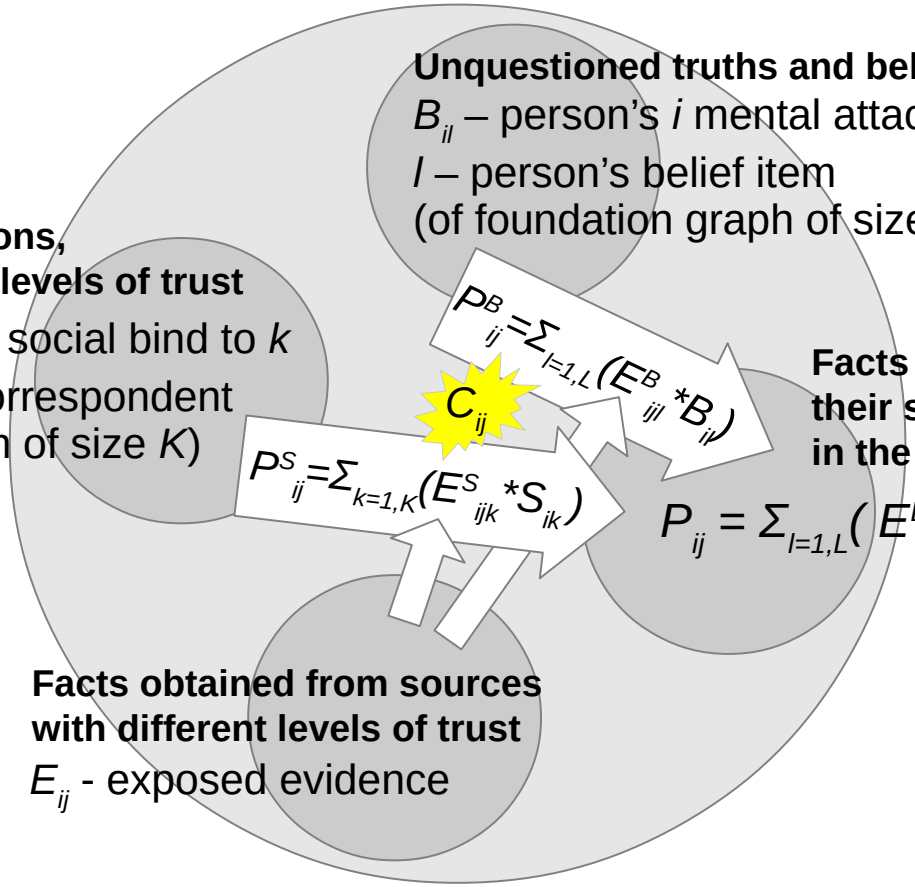
Social evidence-based resource-constrained cognitive-behavioral model



2015-2018

https://ieeexplore.ieee.org/document/7361869
https://www.sciencedirect.com/science/article/pii/S1877050916317239
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Thank you for attention!
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Aigents® - Social computing platform

Ethereum
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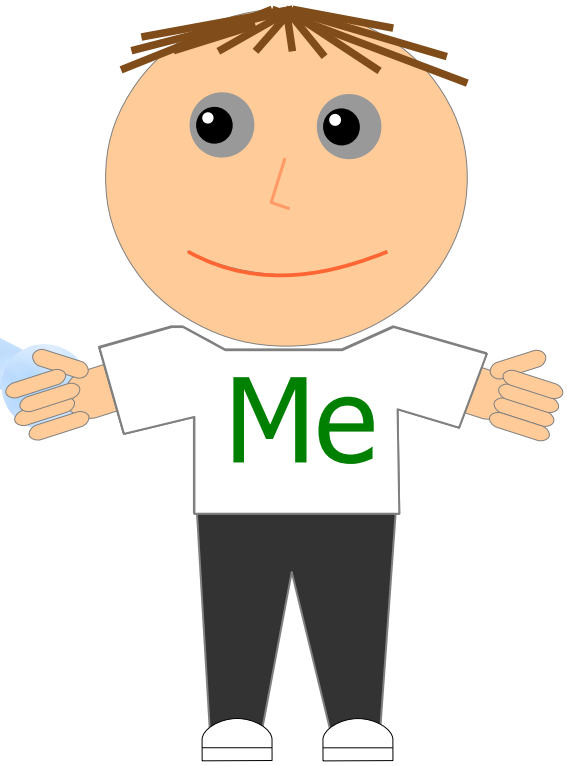
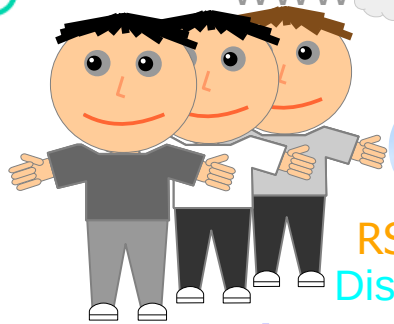
Golos.id
Google
VKontakte
Facebook
Messenger
Slack
Telegram

News



WWW



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https://github.com/aigents

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