

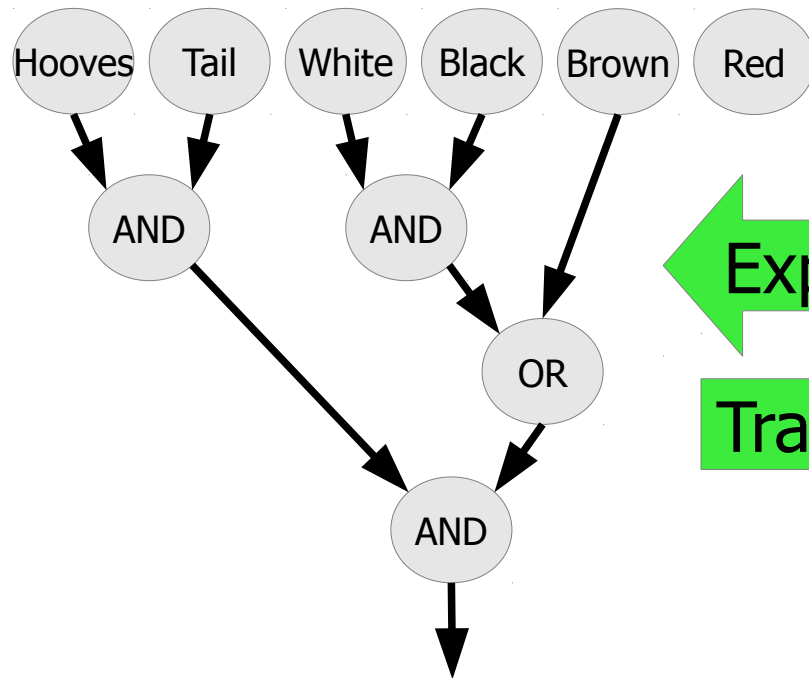
# Foundation Ontology and Semantic Language for Distributed Agents

Anton Kolonin  
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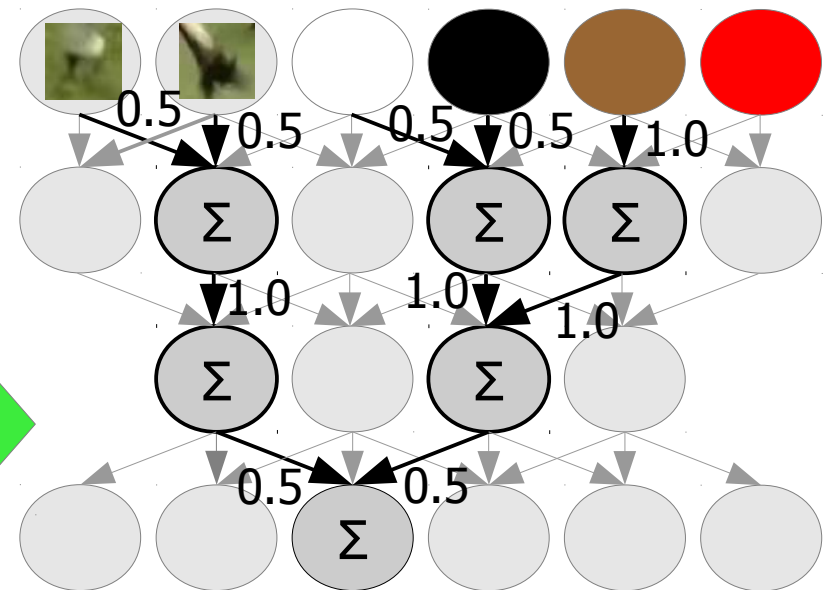
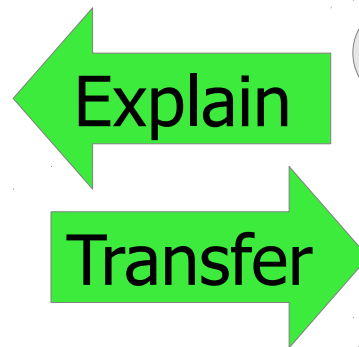
SingularityNET  
<https://singularitynet.io>

# Bridging the Symbolic-Subsymbolic gap for “explainable AI” and “transfer learning”

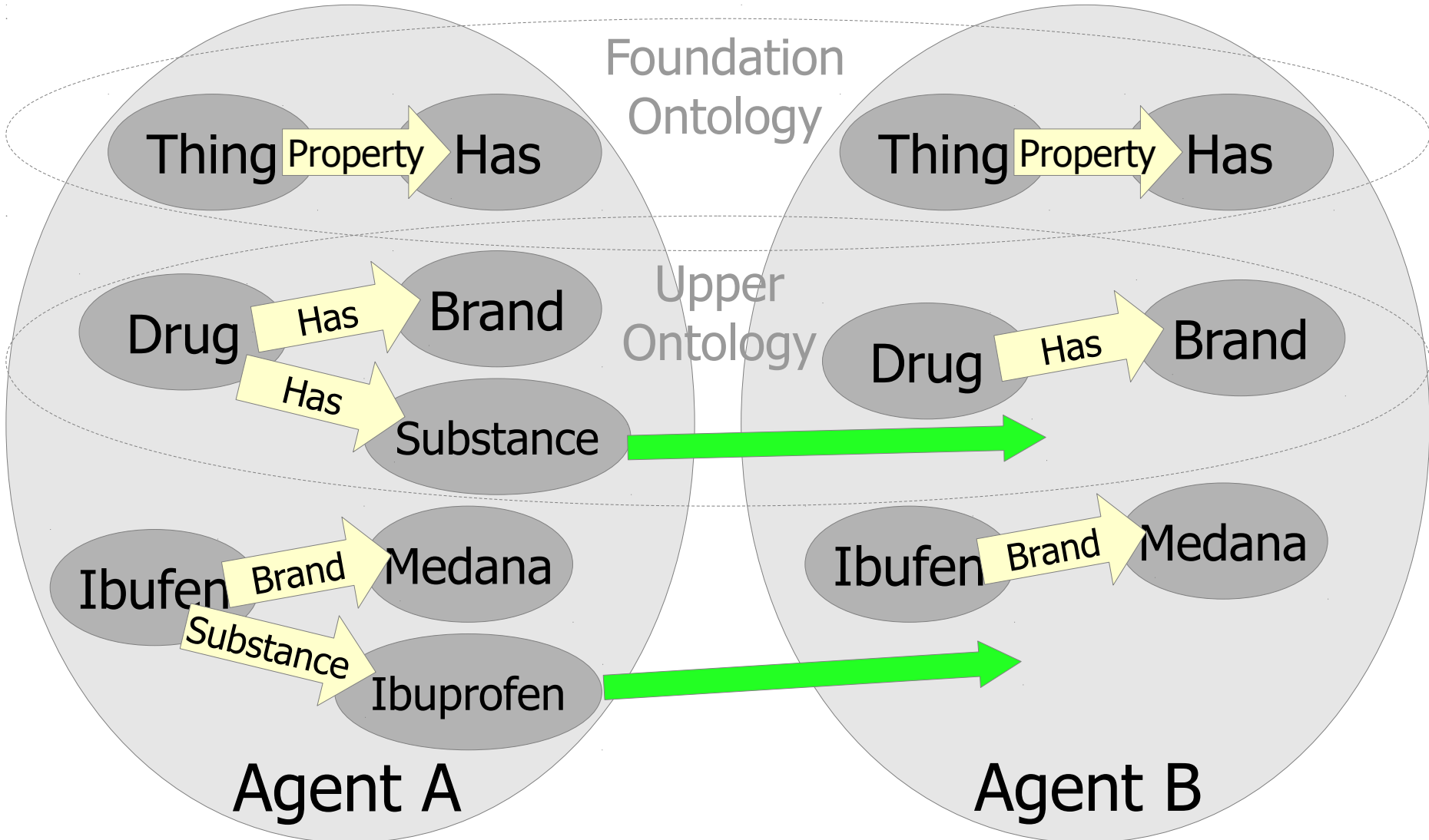


(Hooves AND Tail) AND  
((White and Black) OR Brown)

=> Horse

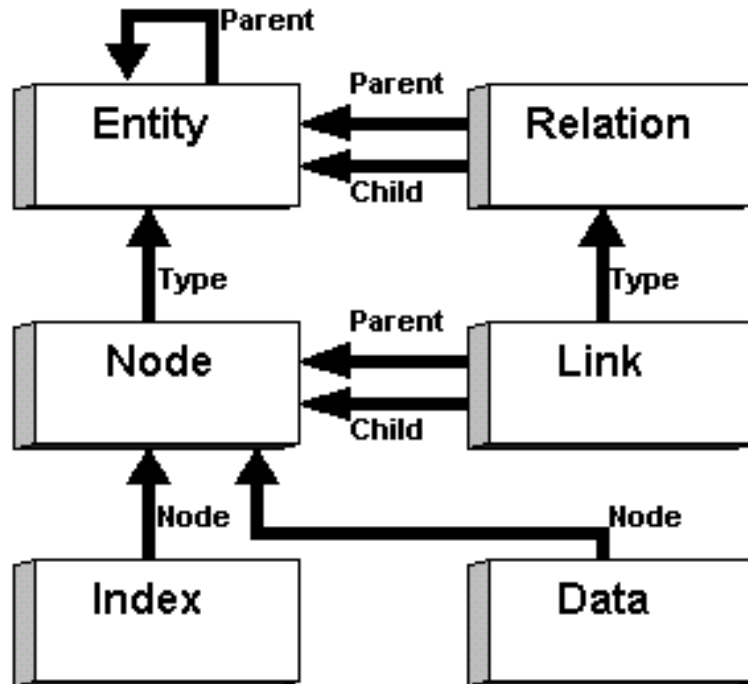


# Foundation Ontologies for Distributed (Multi-Agent) Systems

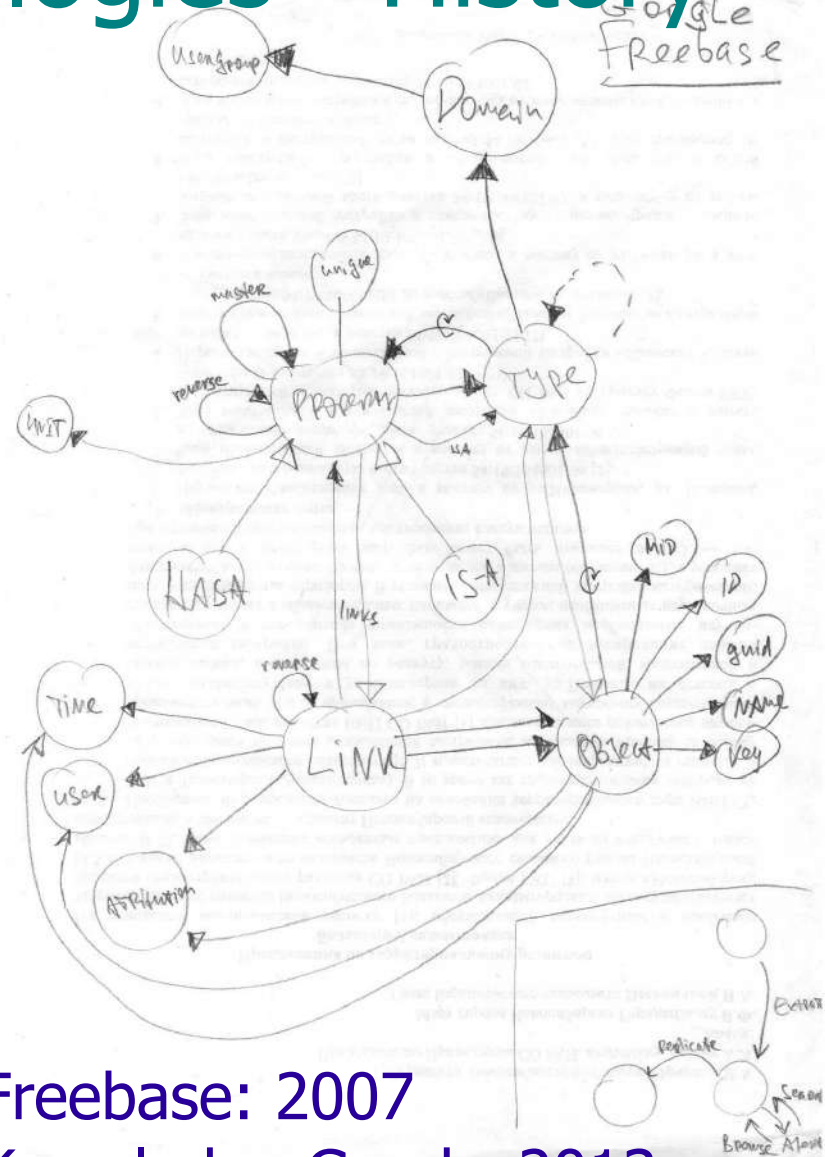


# Foundation Ontologies - History

## Database scheme view



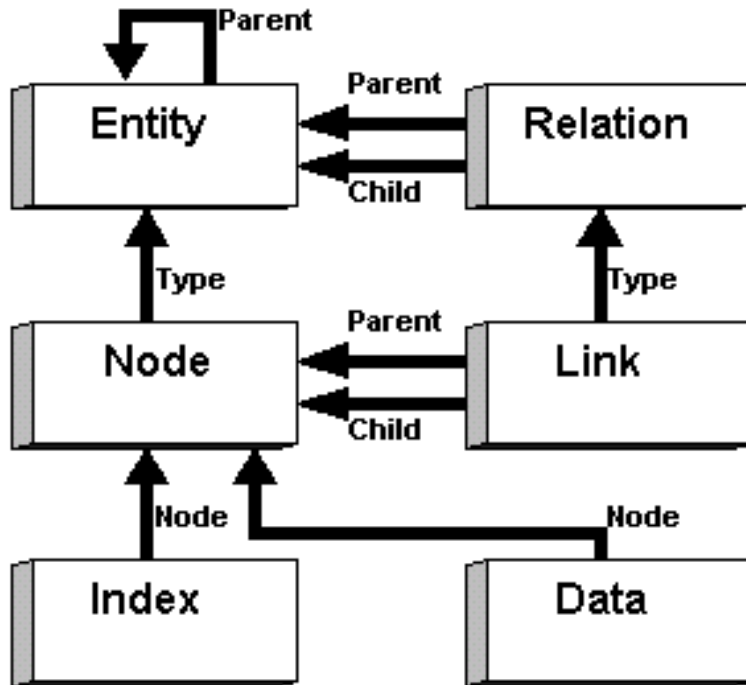
Data4: 1995



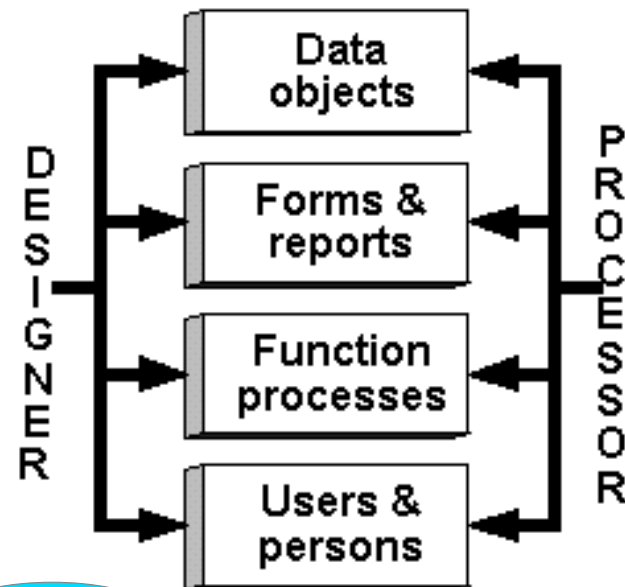
Freebase: 2007  
Knowledge Graph: 2013

# Foundation Ontologies - Applications

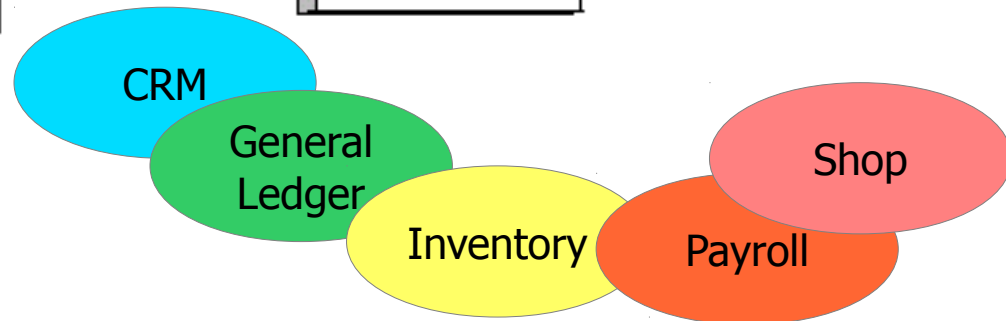
Database scheme view



User interface view



Data4: 1995

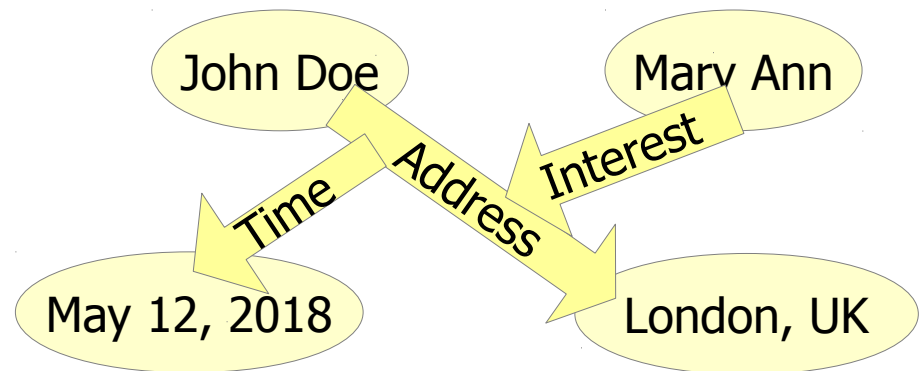
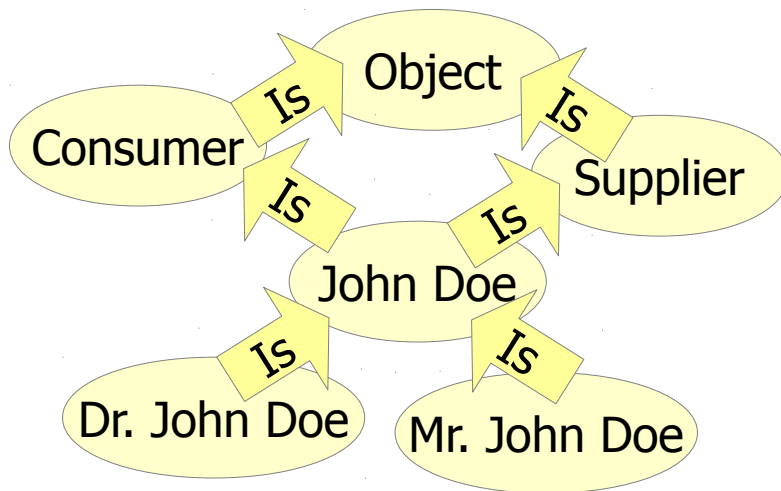


# Lessons Learned:

1. Class is an Object

2. Object may be a Class

3. Link can be a Node





# Semantic Modeling of Business Processes

UFO/URL: 1997-1999

**Дерево классов**

Иерархия классов:

- Сущность(ENTITY)
  - Объект(OBJECT)
    - Данные предметной области(DATA)
      - (DATATEST)
        - Account type(ACCOUNT\_UPDATE\_TYP)
        - Account(ACCOUNT)
          - Browsing accounts(EDIT\_ACCOUNT)
          - Browsing specific account(EDIT\_A)
        - Addresses(ADDRESS)
        - Departments(DEPARTMENT)
        - Document(DOCUMENT)
        - Persons(PERSON)
      - Record(RECORD)
        - Browsing records(EDIT\_RECORD)
      - Атрибут представления(SOURCE\_A)
      - Класс значений 1:M(DOMAIN\_CLASS)
      - Класс представления(SOURCE\_CLA)
      - Класс элементов M:1(ELEMENT\_CLA)
      - Класс, выбирающий значения(CLAS)
      - Сводное представление(SUMMARY)
    - Справочная информация(DICTIONAR)
      - Адрес(ADDRESS)
      - Контактный телефон(PHONE)
      - Предприятия(ENTERP)
      - Субъекты(SUBJECT)

Атрибуты: Методы: Объекты:

Имя	Текст	Дос	Ключ	№ п/п	Об	Па	Тип	Область значений
NUMBER	Account code	unique	0				Embedded	->STRING
ACC_TYPE	Account type	no	0				Embedded	->STRING
DEBET	Debit	no	0				Embedded	->NUMBER
CREDIT	Credit	no	0				Embedded	->NUMBER
SALDO	Balance	no	0				Embedded	->NUMBER
COLOR	Color		0				EMBICALL	->NULL

Атрибуты: Методы: Объекты:

Имя	Текст	Тип	Обращение	Таблица	Атри
GET_ACCOUNT_COLOR	Paint account	SET			[...]
CONVERT_SALDO	Make balance				[...]
UPDATE_DEBET	Update account balance				[...]

Paint account(GET\_ACCOUNT\_COLOR)

- 01. DO\_RET = YELLOW
- 02. IF ALL IF =
  - IF DEBET > CREDIT
    - LET
      - 01. DO\_RET = GREEN
- 03. IF ALL IF =
  - IF DEBET < CREDIT
    - LET
      - 01. DO\_RET = RED

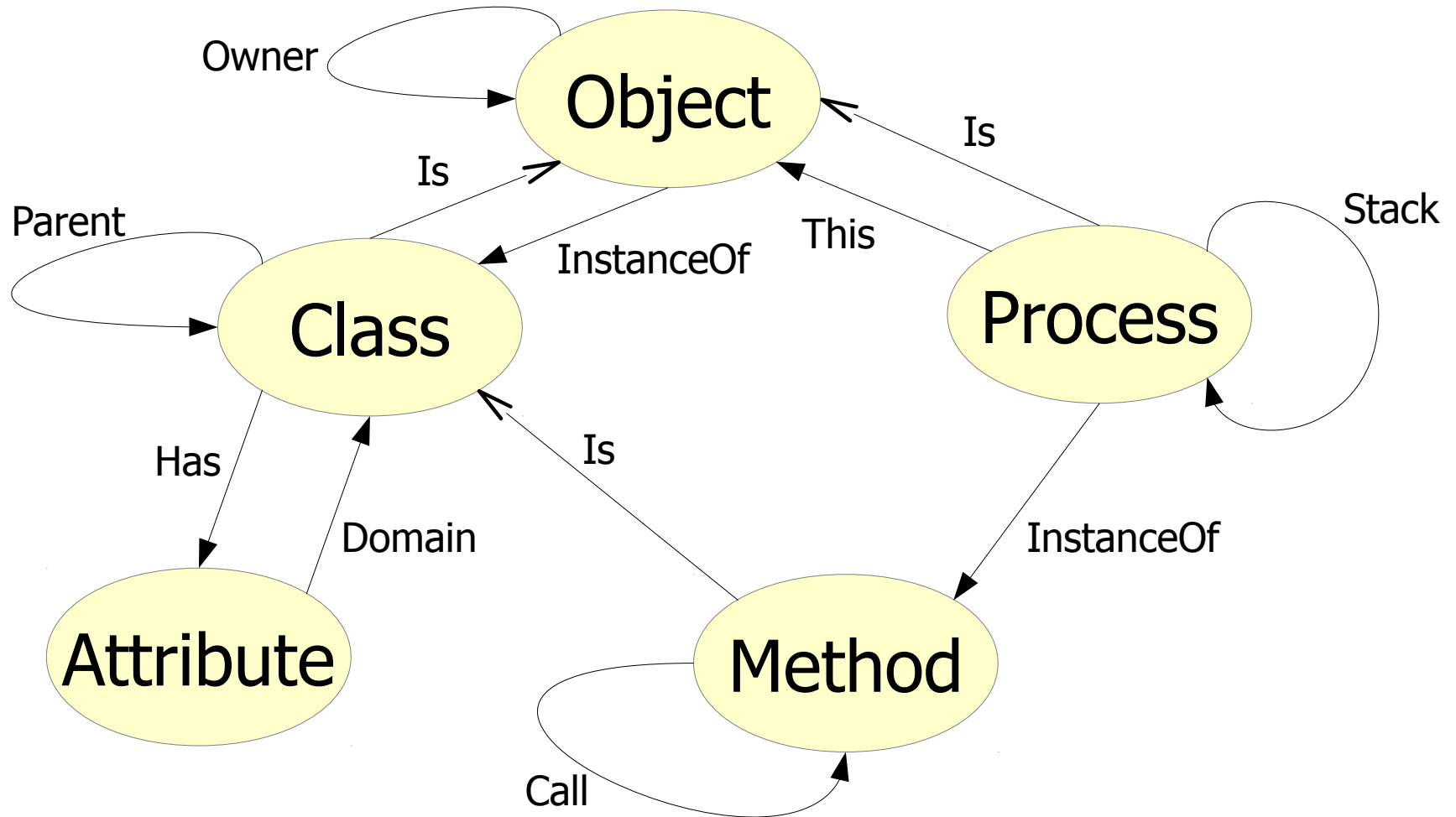
Operational day: 01/04/2000

**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 development 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).

# Semantic Modeling of Business Processes

UFO/URL: 1997-1999

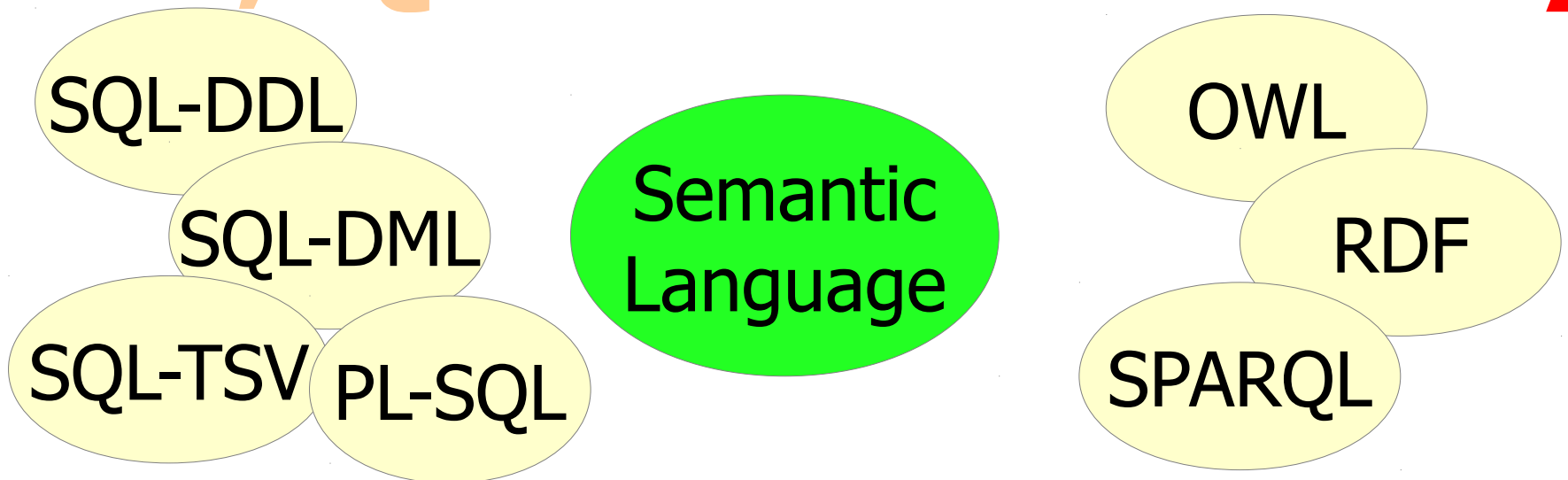
Foundation Ontology





# Lesson Learned:

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



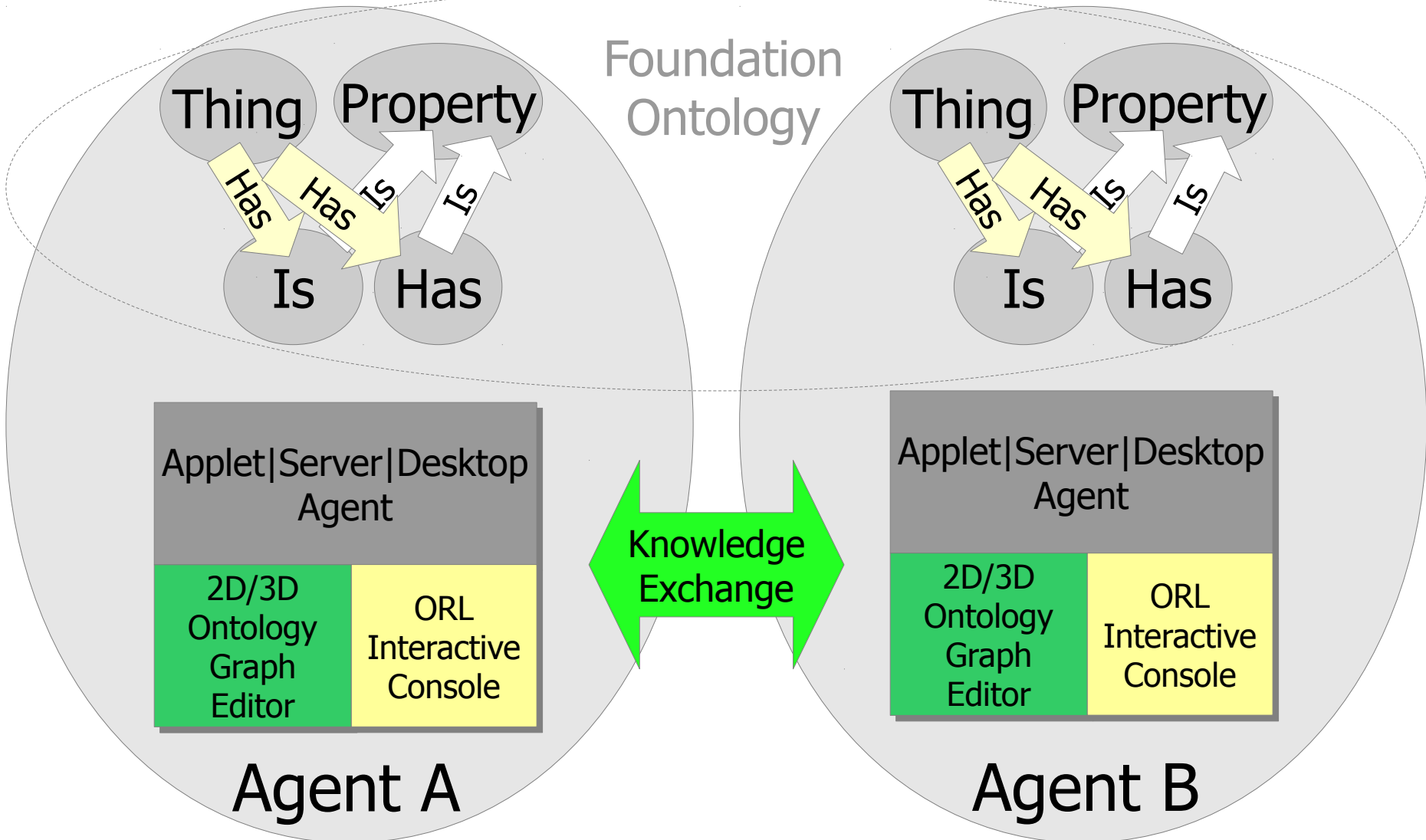
# Semantic Modeling of Business Processes

## 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;;

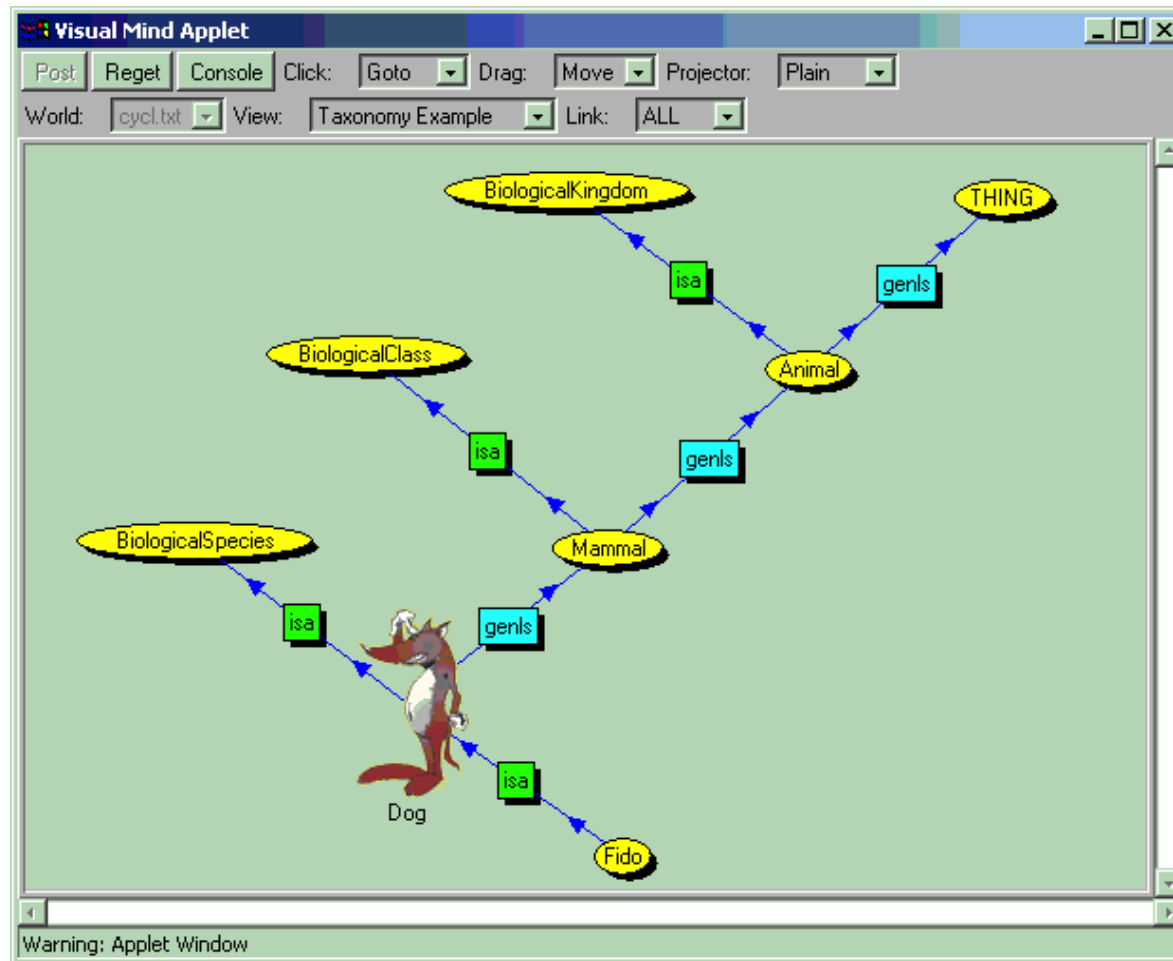
# Distributed Knowledge Editor

## Webstructor: 2001-2006



# Webstructor: Distributed Knowledge Editor

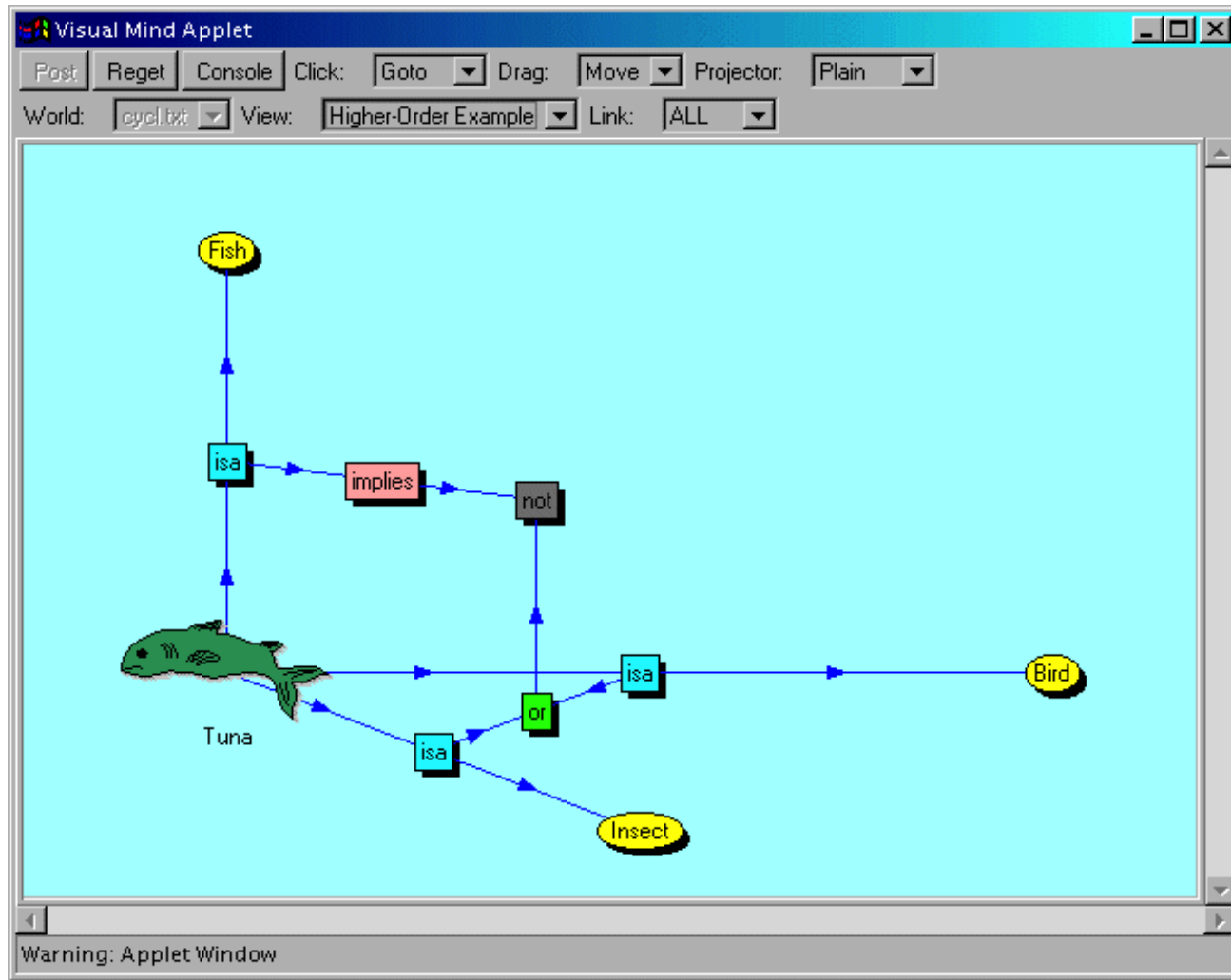
## Visual ontology editor - representing Cyc «micro-theory»



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

# Webstructor: Distributed Knowledge Editor

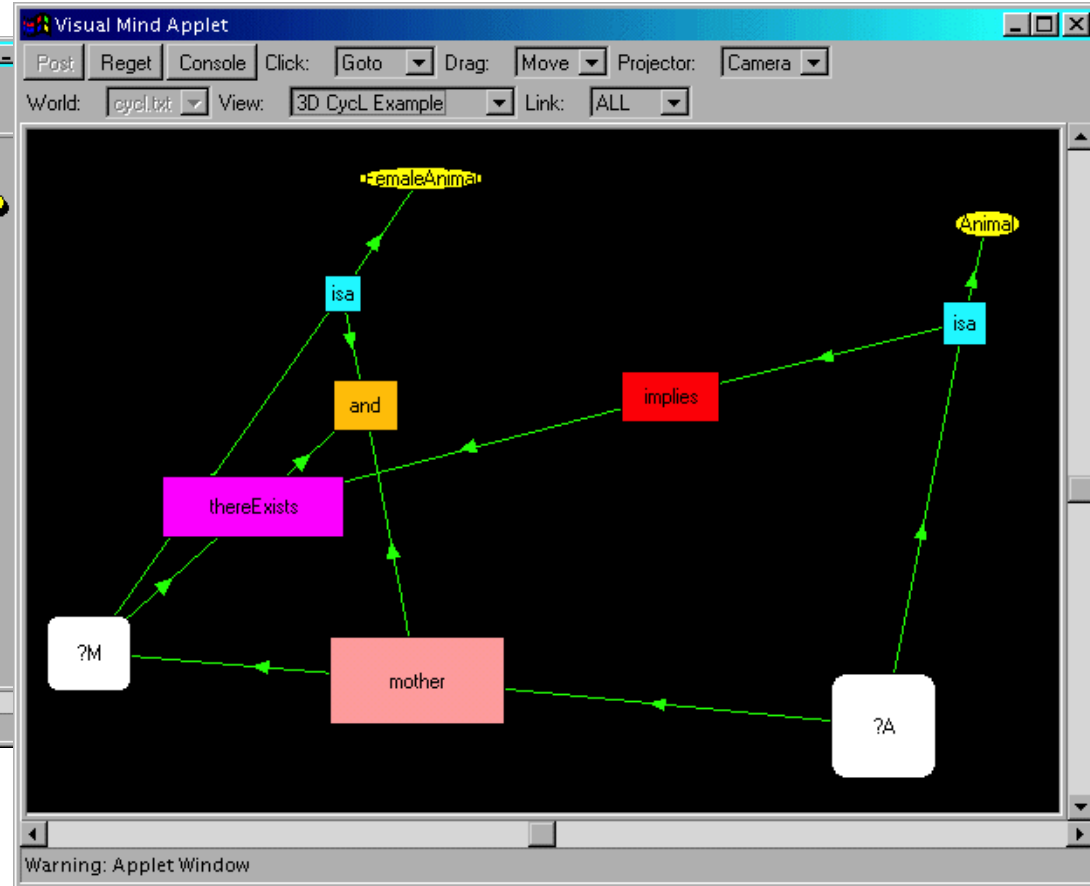
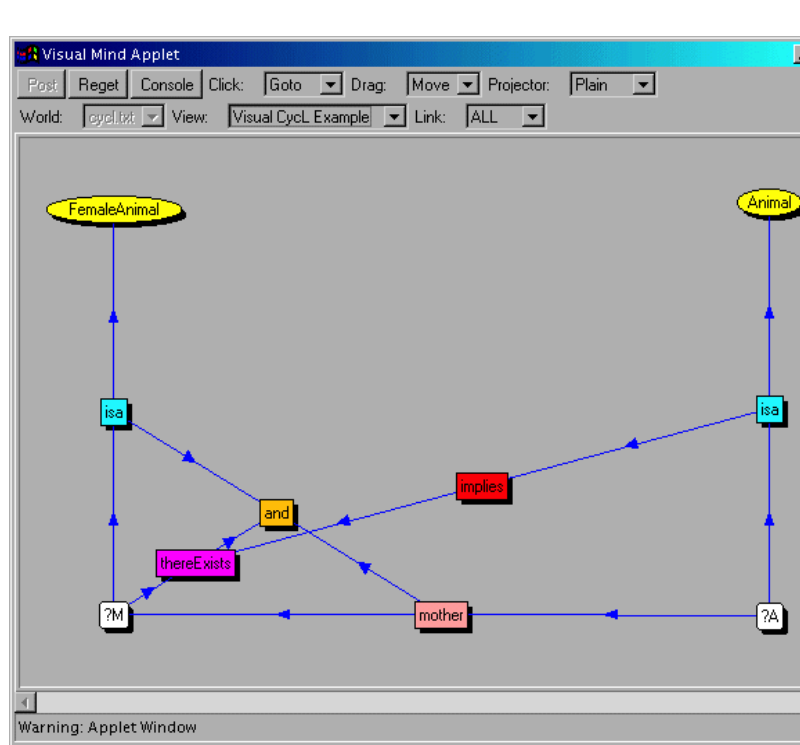
## Visual ontology and predicate logic formula editor



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

# 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.



# 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**

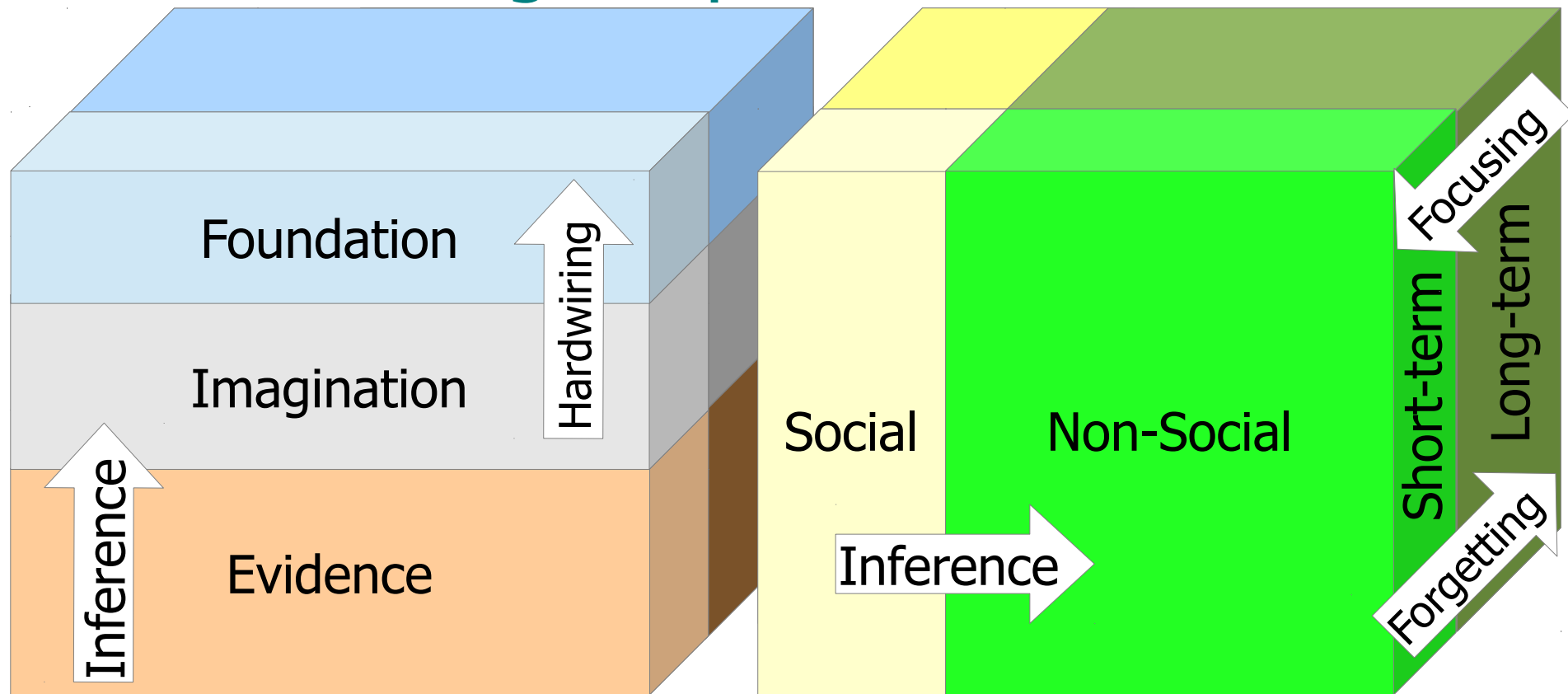
# Aigents® Platform for Distributed Personal Agents



Monitoring  
content and  
social dynamics  
in online  
networks

Anton Kolonin  
[akolonin@aigents.com](mailto:akolonin@aigents.com)

# 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.

# Using “Semantic Language” for Knowledge Transfer between Software Agents and Human Users

Lisp, AIML/XML,  
RDF/OWL/XML + SPARQL,  
Turtle, JSON-LD

Too complex and unfriendly?

“Interlingua”  
“Controlled language”  
“Semantic language”

Just right!

Lojban,  
Esperanto,  
English

Too complex and ambiguous?

Artificial  
Agent

Human  
User

# 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.

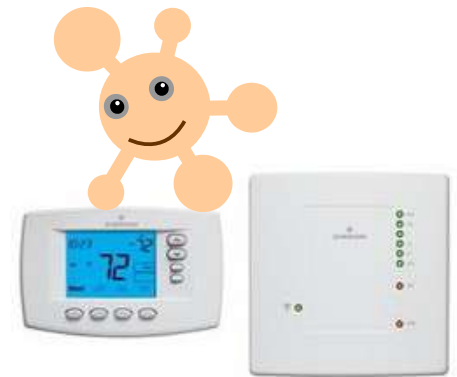
A: My has temperature, humidity, CO2, feeling.

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.

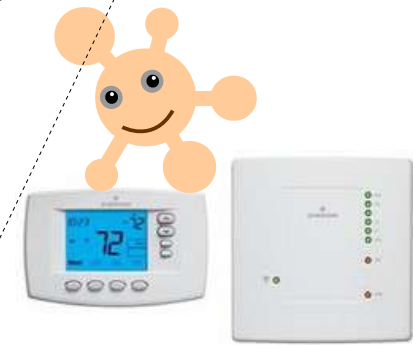
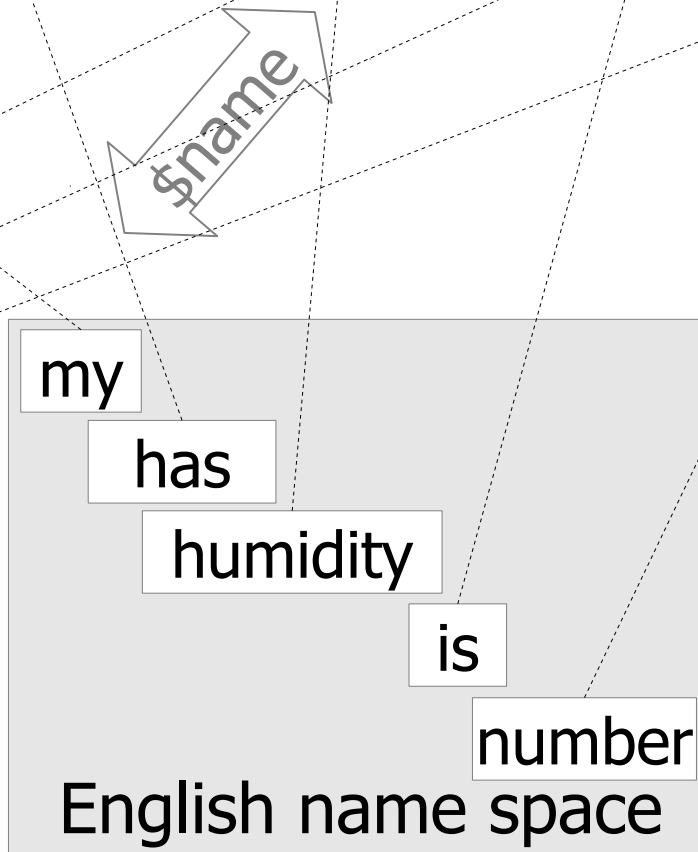
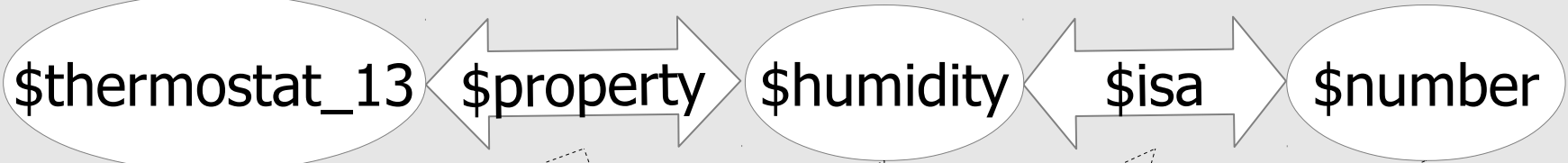
A: Самочувствие это хорошо или плохо.

H: Как твоя самочувствие, температура, влажность?

A: Моя самочувствие хорошо, температура 20, влажность 72.

# Agent Language (AL) as a “Labeled Turtle”

Common domain-specific ontology for “controlled interlingua”





# Agent Language (AL) as a Graph Manipulation

## Interrogation:

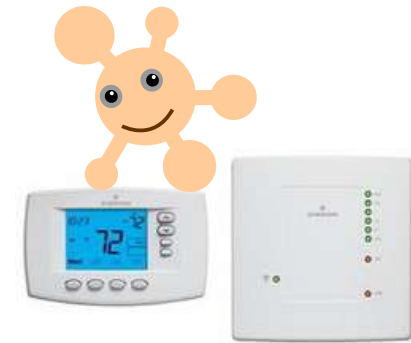
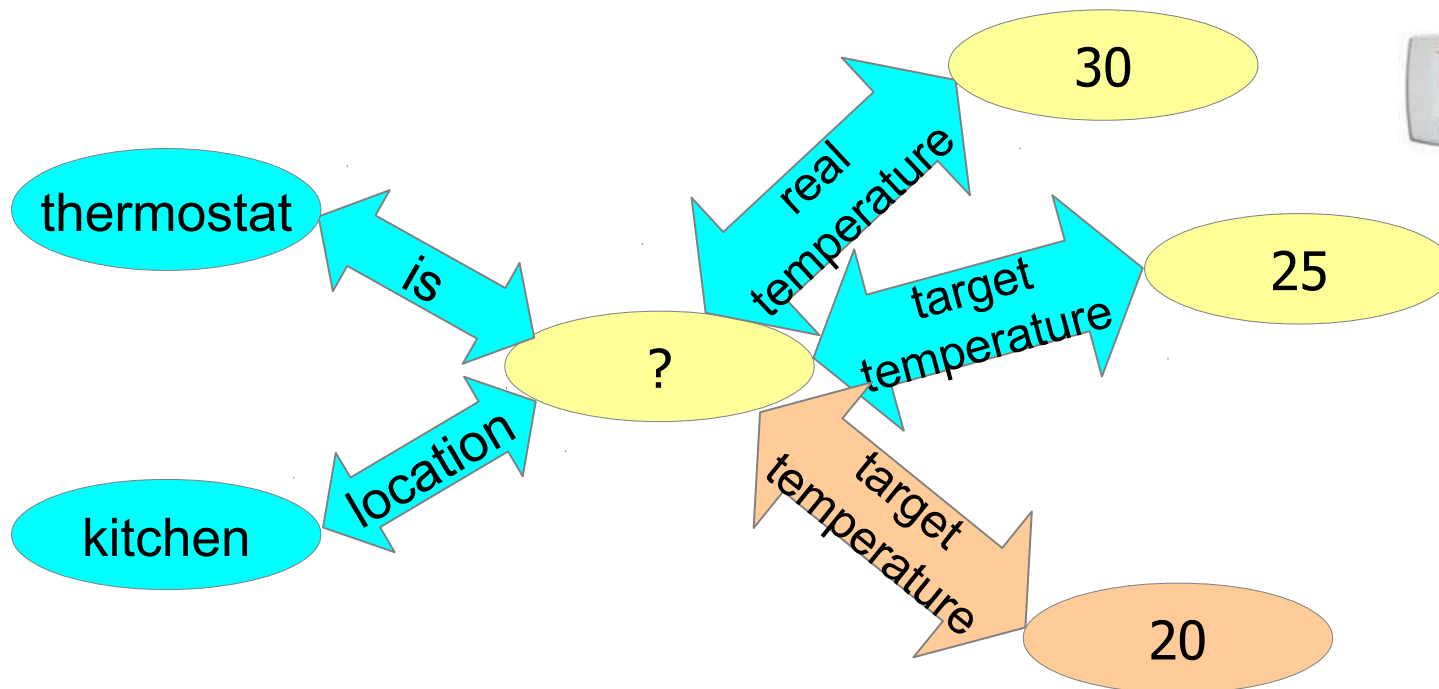
What is thermostat, location kitchen real temperature, target temperature?

## Declaration:

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

## Direction:

Is thermostat, location kitchen target temperature 20!



# 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

# 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

I (can (eat, sleep), want (dance, sing)).  
I {can (eat, sleep), want (dance, sing)}.  
I (can {eat, sleep}, want {dance, sing}).  
You [eat (rice, meat), drink {tea, beer}]!

## Agent Language - spoken

I can eat and sleep and want dance and sing.  
I can eat and sleep or want dance and sing.  
I can eat or sleep and want dance or sing.  
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.

# Aigents® Upper Ontology for Online Media Monitoring & Studies

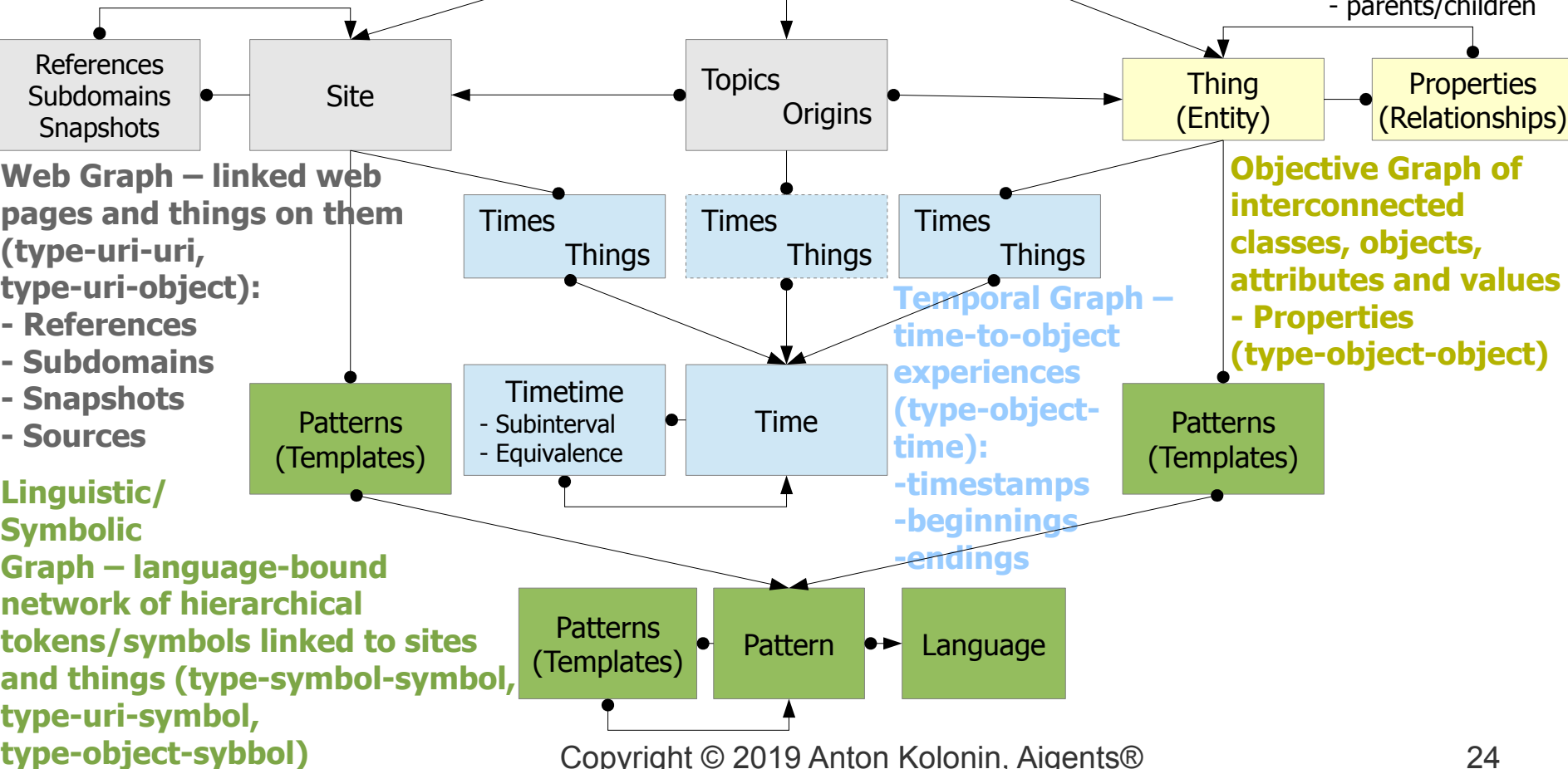
**Personal Graph - person-to-object relationships map (type-subject-object):**

- Topics (in Things)
- Shares
- Likes

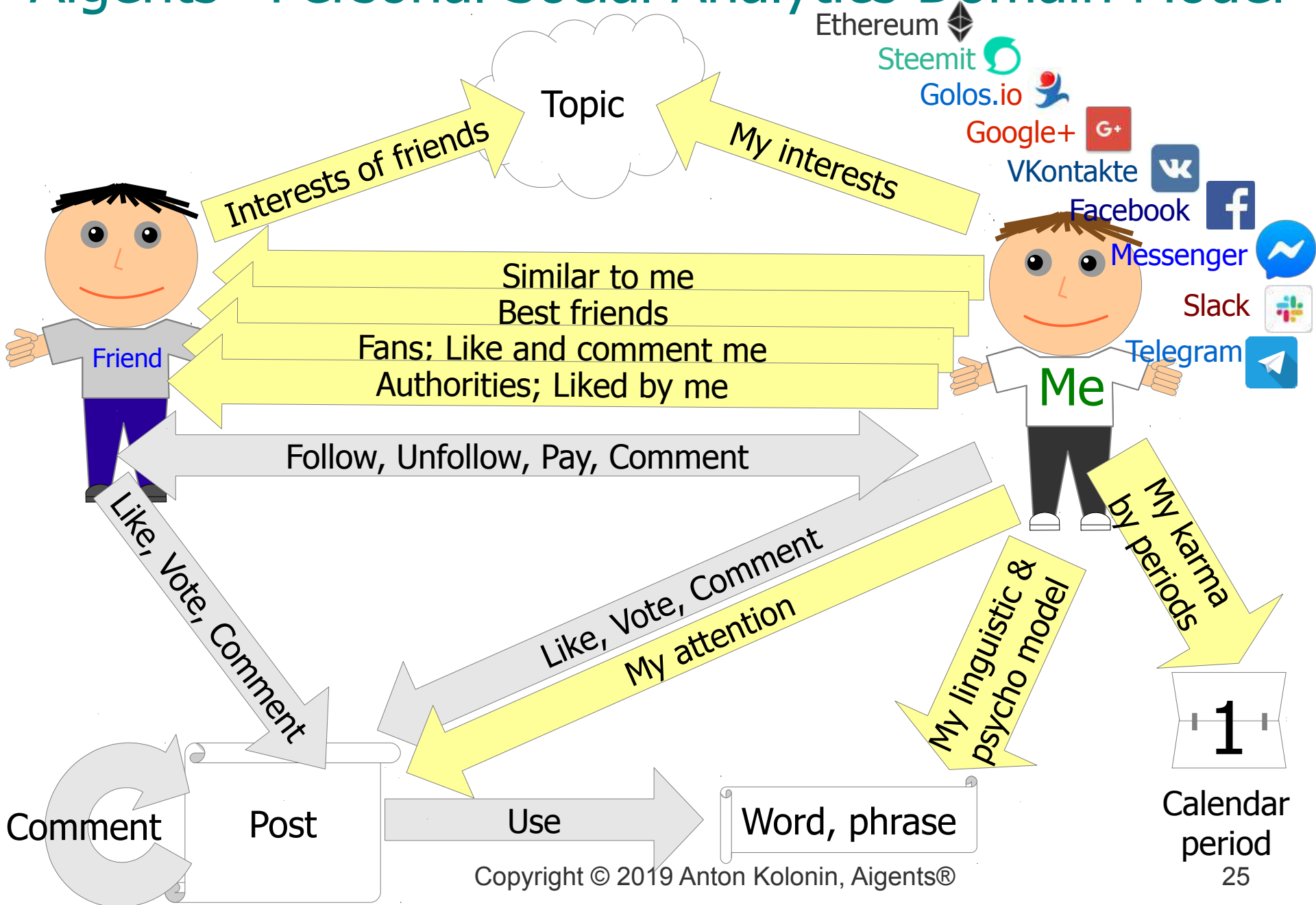
**Social Graph – person-to-person trust/confidence relationships (type-subject-subject):**

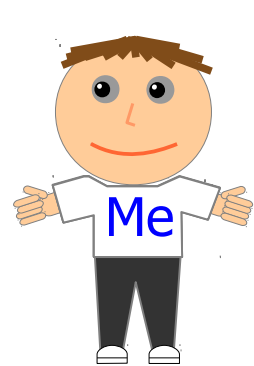
- Followers/Takes
- Sharers/Gives

- owners/properties
- classes/instances
- parents/children

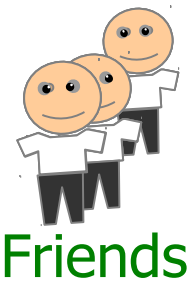


# Aigents® Personal Social Analytics Domain Model





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



Screenshot of the Aigents website interface showing a search for 'trump' and a list of news results.

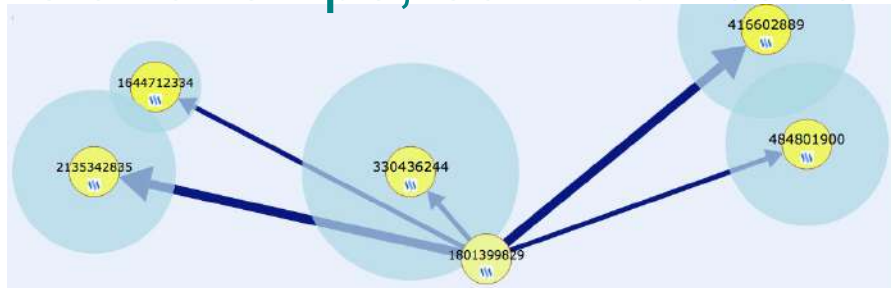
The interface includes a navigation bar with links: Agents, Topics, Sites, News, Friends, Graph, Chat. A search bar contains the text 'trump'. A 'Login & Registration' link is visible on the right.

The search results are displayed in a list format, categorized by date:

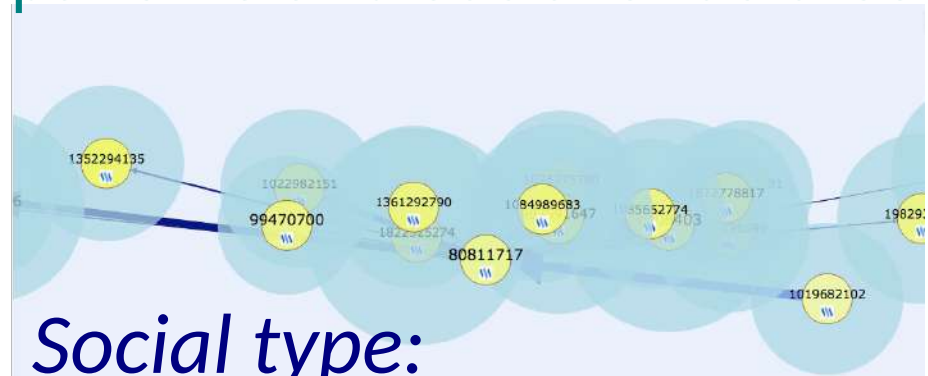
- today**
  - clapper was one of four top security and intelligence officials who put their names behind a january 6 report that said russian president vladimir put behind a complex effort of hacking and misinformation to influence the 2016 election in trump's favor  
<http://www.digitaljournal.com/news/world/hollywood-stars-ex-spl-es-launch-russia-investigation-campaign/article/502876>
  - sections business markets world politics tech commentary breakingviews money life pictures reuters tv discover thomson reuters financial go solutions legal reuters news agency risk management solutions tax & accounting blog: answers on innovation @ thomson reuters directory of contact support featured shock tactics the garage science behind tasers immigration policy trump administration red tape tangles up visas for foreigners  
<http://www.reuters.com/theWire>
- today**
  - the more intense scrutiny comes after president donald trump called for a review of the controversial program  
<http://www.reuters.com/video/2017/09/20/red-tape-ties-up-h-1b-visas-for-skilled?videoId=372572112&videoChannel=1>
- yesterday**
  - and is examining any financial entanglement between russia and president trump his associates  
<http://www.nytimes.com/>
- 2017-09-14**
  - president trump came under sharp attack on thursday for appearing to set aside a border wall fight while reaching a deal on daca immigrants  
<http://www.nytimes.com/>
- 2017-09-10**
  - lawrence... on trump's...  
<http://www.nytimes.com/>



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.



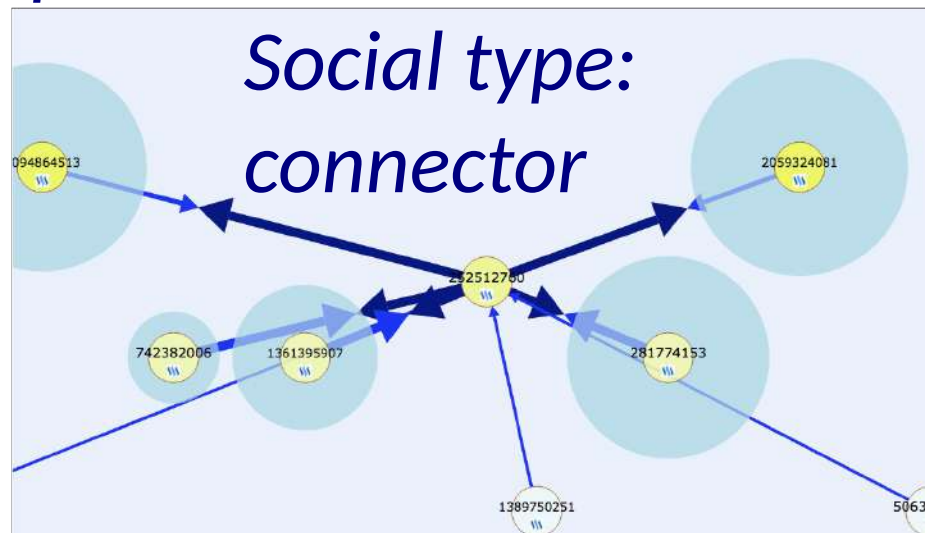
*Social type:  
follower*



*Social type:  
peer*



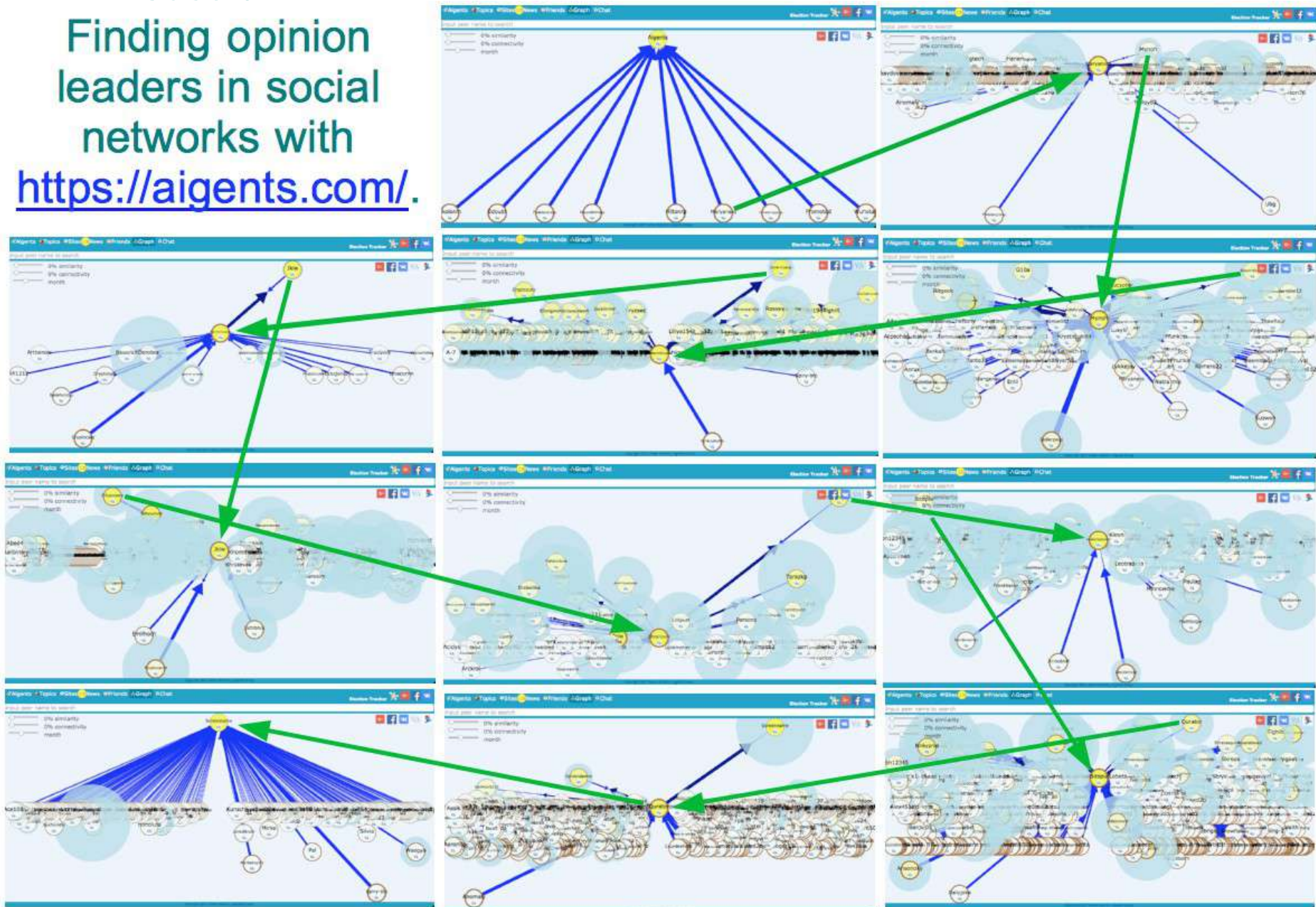
*Social type:  
opinion leader*



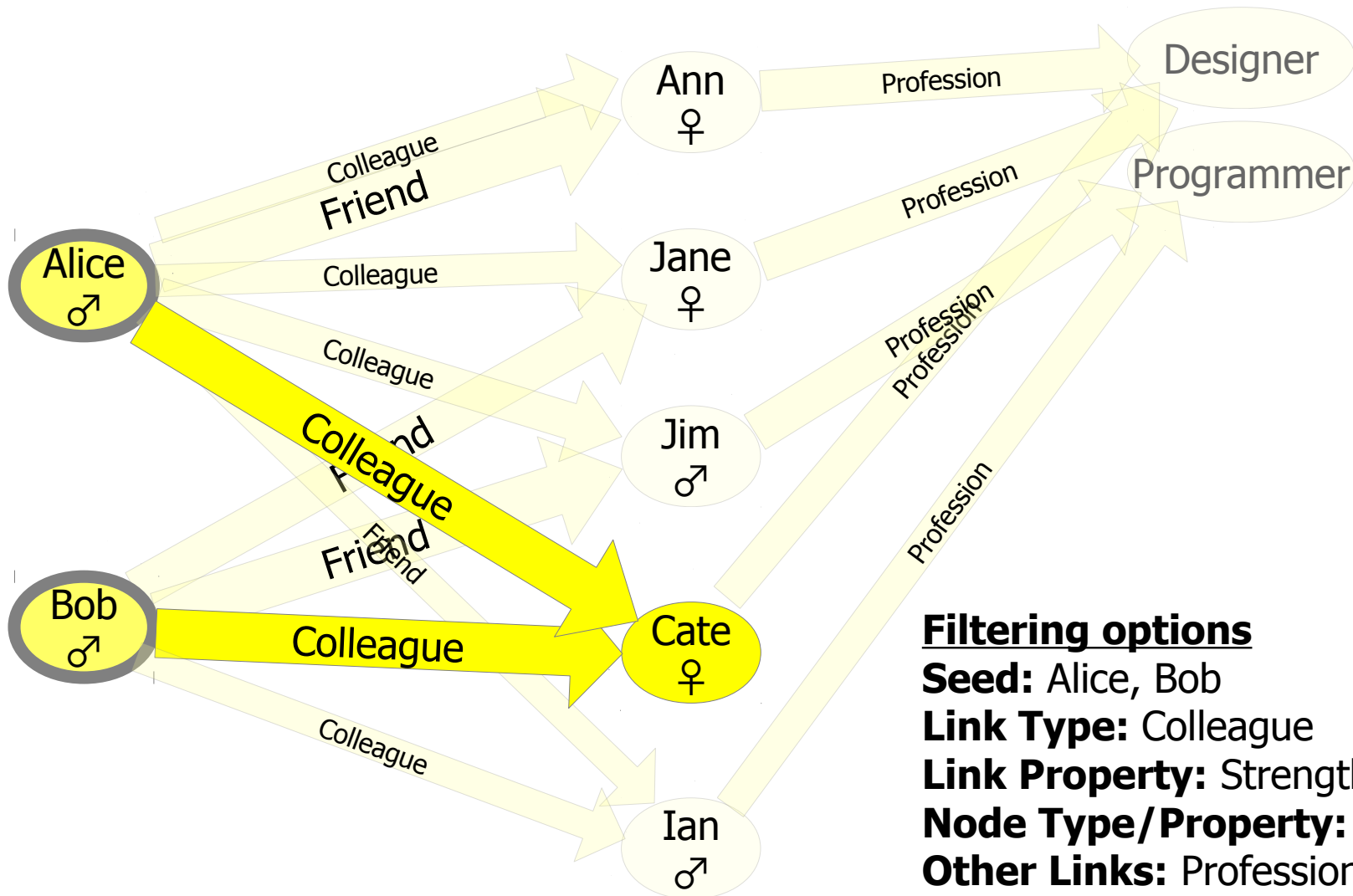
*Social type:  
connector*

# Case 3:

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

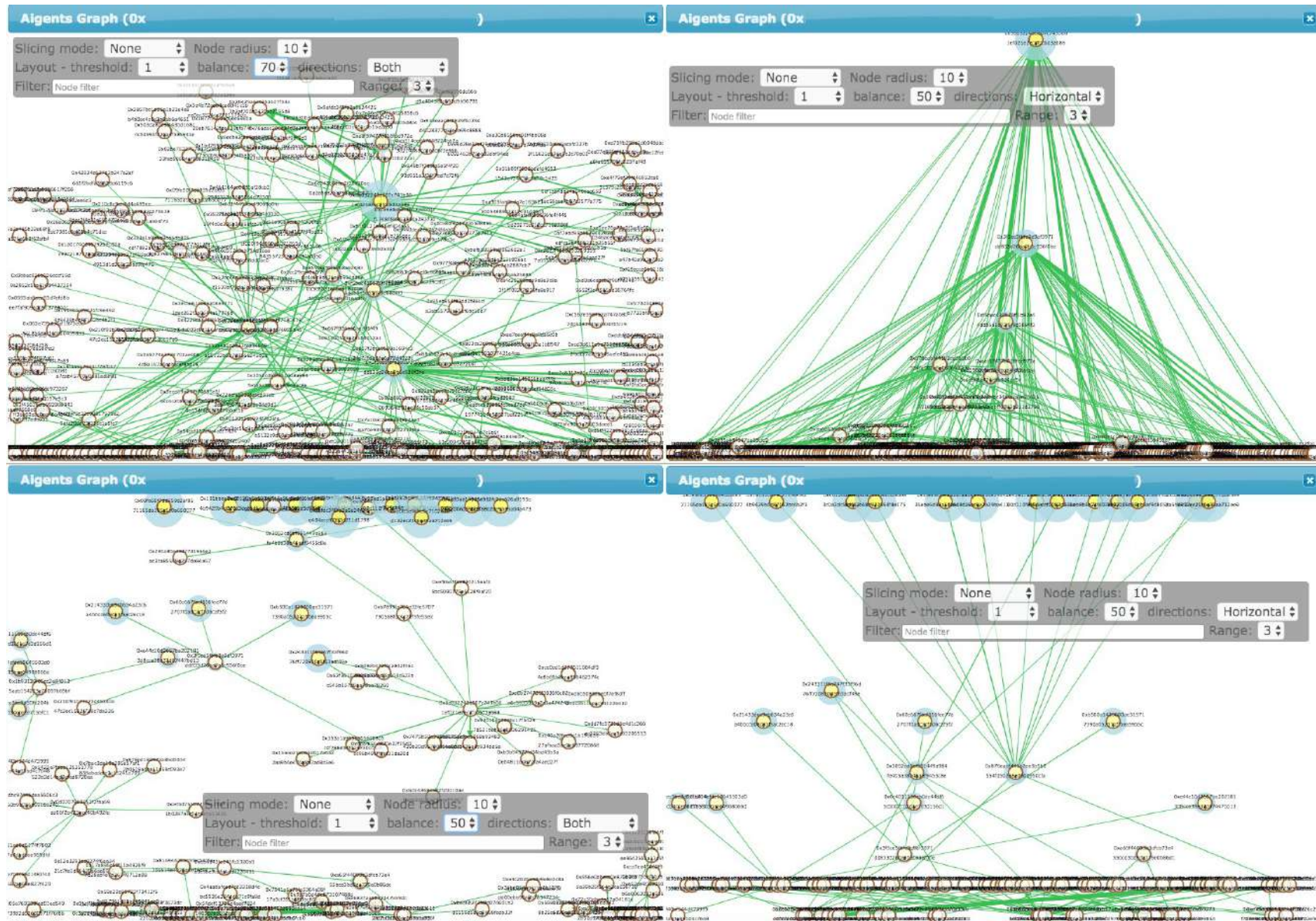


# Aigents®: Graph Builder and Filter

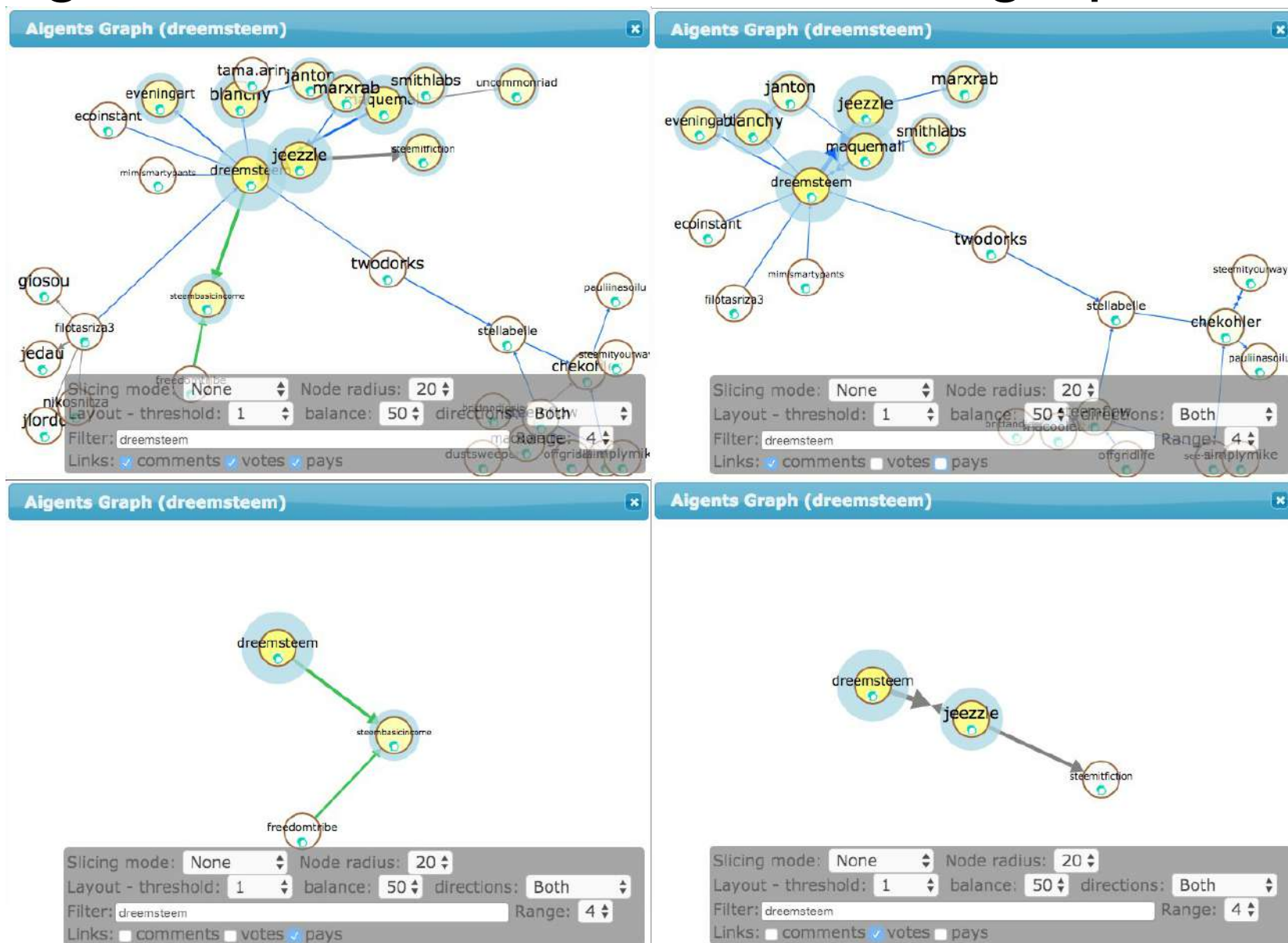




# Aigents®: Ethereum cash flow graph study



# Aigents®: Steemit social network graph study



# Thank you for attention!

## Questions?

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Youtube: <https://www.youtube.com/aigents>

Medium: <https://medium.com/@aigents>

Steemit: <https://steemit.com/@aigents>

Facebook Messenger: [Aigents](#)

Telegram Messenger: [@AigentsBot](#)



SingularityNET

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University  
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TravelChain



**zkylos**