Distributed knowledge engineering and (social) evidence-based knowledge representation in multi-agent systems

Anton Kolonin
Aigents Group
http://aigents.com
KESW-2015 Conference
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**Goal:** Social intelligence platform for real-time evaluation of group belief system for collaborative decision making and opinion delivery in social environments

Benefactors (who get paid)

Beneficiaries (who pay)

Group belief formation, analysis and delivery

Contribute Beliefs (Content)

Consume Beliefs (Content)

Consume Beliefs (Ads)

Contribute Beliefs (Ads)
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**Requirement 1:** Distributed (decentralized) storage of knowledge in “peer-to-peer” multi-agent network

Java is coffee

Java is language

Java is island

Java is language

Java is coffee
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Approaching distributed multi-agent architecture
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**Requirement 2:** Dynamic evaluation of truth value based on social profiling and temporal scoping

**Social profile**

- Educated professional
- Regular citizen

**Time**

- 10 century
- 20 century

- Java is language
- Java is coffee
- Java is island
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Belief systems in social multi-agent environments
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Compassion-based artificial psyche (Webmind)

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Fuzzy Logic: Non-Axiomatic Reasoning System (NARS)

Bad nutrition → Weakened immune system → Infection

Revision

Always

Yesterday

Today

Abduction

Induction

Deduction

Cold → Infection

Truth value: Strength, Confidence

Fuzzy Logic: Separating Strength and Confidence

- **Bad nutrition**: 9/10 High strength, Low confidence
- **Weakened immune system**: 60/100 Low strength, High confidence
- **Infection**: 90/100 High strength, High confidence
- **Cold**: 6/10 Low strength, Low confidence

**Truth value**: Strength, Confidence

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Social evidence-based cognitive model

- **Foundation graph**
  - Mary is friend of mine
  - Peter is friend of mine
  - Bob is co-worker of mine
  - Bob is friend of Peter
- **Communication graph**
  - 1997: Bob is programming in Java
  - 1998: Peter visited Java
  - 1999: I am programming in Java
  - 2011: Mary visited Java
  - 2012: Peter is programming in Java
  - Yesterday: Peter and me drink Java
  - Today: Mary and me drink Java
- **Evidence graph**
  - 1997: Bob is programming in Java
  - 1998: Peter visited Java
  - 1999: I am programming in Java
  - 2011: Mary visited Java
  - 2012: Peter is programming in Java
- **Imagination graph**
  - 1997: Bob is programming in Java
  - 1998: Peter visited Java
  - 1999: I am programming in Java
  - 2011: Mary visited Java
  - 2012: Peter is programming in Java
- **Inference engine**
- **Belief, matter of trust**
  - | I is co-worker |
  - | friend drink |
  - | programming |
- **Current world image**
  - Java
  - (9)
  - Java coffee
  - (4)
  - Drink Java coffee
  - (4)
  - Program in Java language
  - (3)
  - Java island
  - (2)
  - Visit Java island
  - (2)

Trusted social references

Matter of experienced and communicated facts
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Applying resource constraints to the model
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Webstructor: Distributed visual knowledge editor - 2D

Part of “biological kingdom” of Cyc “upper ontology”

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Webstructor: Distributed visual knowledge editor - 2D

Formula: “If tuna is a fish, it implies it is not an insect or a bird”

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Webstructor: Distributed visual knowledge editor - 3D

CycL formula editor:

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Webstructor: Distributed visual knowledge editor - 3D

Representing complex spatial data in hyper-space

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Thank you for attention!

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Webstructor: Sharing “world” data visible in “views”

World: Shared hyper-graph

Agent A
- View 1
- View 2
- View 3

Agent B
- View 3

Agent D
- View 4
- View 5
- View 6

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Webstructor: Types and functions of agents

Communication cloud - over HTTP or TCP, using Object-Relational Language (ORL)

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

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Belief representation: Hierarchical hyper-graph

Abstract Cognition

Objective Cognition

Visual Perception

Audial Perception

Tactile Perception

Olfactory Perception

Linguistic Cognition

Social Cognition

Emotional Perception

Belief representation:
Hierarchical hyper-graph

Belief representation:
Hierarchical hyper-graph