

# Towards a healthy Explorative Mind-map framework and beyond

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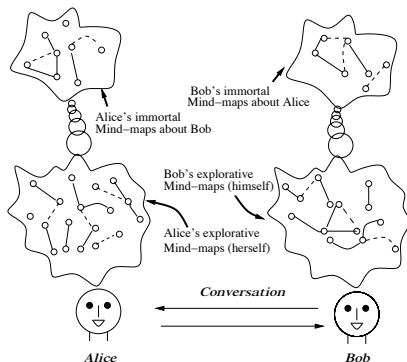
University of Luxembourg  
ILIAS Laboratory - MINE Group

Internal Seminar (October 21, 2009)

# Outline

- 1 Introduction
  - Conversational Model
  - Human mind and Mind-map
  - Computational Trust
- 2 Explorative Mind-map
  - Mind-map Health
  - Architecture
  - Pattern Formation Techniques
- 3 Mind Theory and Mind-map
- 4 Factors related to Trust
- 5 Summary

# Conversational Model



Conversation between *Alice* and *Bob*

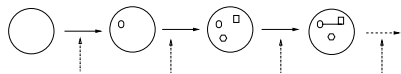
## Processing of information inside the Mind

- 1 *Alice's* own world
- 2 *Alice's* understanding about the world of *Bob*
- 3 *Bob's* own world
- 4 *Bob's* understanding about the world of *Alice*

# Human Mind and Mind-map



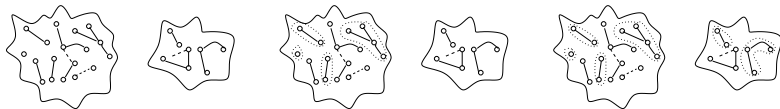
The innocent brain of a child is empty



Gradually she develops her learning ability  
... With the following major characteristics ...

- Adaptive
- Explorative
- Associative
- Incremental
- Temporal

# Computational Trust



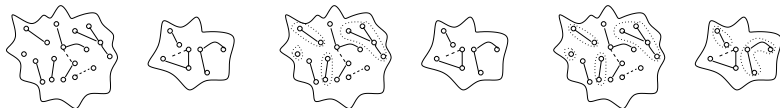
*self-relevances* vs. *outer-relevances*

*self-skeletons* vs. *outer-relevances*

*self-skeletons* vs. *outer-skeletons*

$$\text{match}(\text{self}, \text{outer}) = \frac{\text{The total number of similarity among the self and outer patterns}}{\text{The number of outer patterns}}$$

# Computational Trust



*self-relevances* vs. *outer-relevances*

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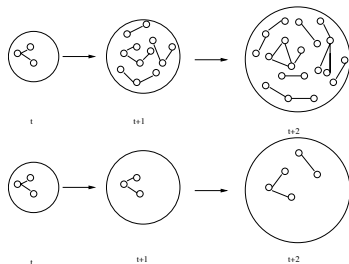
$$match(M_p, M_{pq}^*, t) = \sum_{i=1}^k \sum_{j=1}^l \frac{|\rho^{M_p}(\mathbf{e}_i, t) \cap \rho^{M_{pq}^*}(\mathbf{e}_j, t)|}{|\rho^{M_p}(\mathbf{e}_i, t)|}$$

$$trust = \begin{cases} \text{yes,} & \text{if match} \geq \text{threshold} \\ \text{no,} & \text{else} \end{cases}$$

# Outline

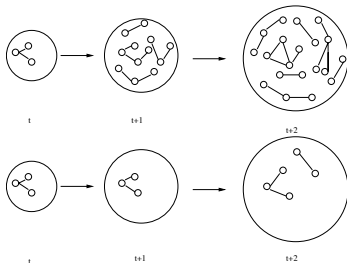
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# Mind-map Health

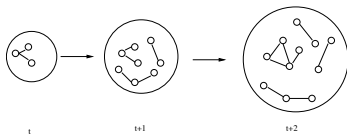


Fever and Frozen states of the Mind-map

# Mind-map Health



Fever and Frozen states of the Mind-map



Healthy Mind-map

## Our Goal

Find out the most suitable machine learning algorithms, which will keep the mind-map in healthy state.

Initially we came with following propositions(\*)

- **Temperature** :  $\epsilon_{min} \leq \tau \leq \epsilon_{max}$
- **Energy** :  $\eta_p = \sum_{i=1}^m a_i$   
( $a_i$  = activation value)
- **Capacity** :  $\chi$  is a binary (0/1)

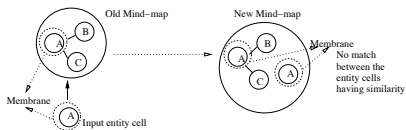
parameter, depends on ...

- Number of patterns ( $n$ ) inside the mind-map
- Number of cells and their connections ( $m$ ) inside a pattern
- The temperature  $\tau$  (depends on the complexity (=  $\frac{|c_i|}{|e_i|}$ ) of the patterns)

- **Pattern Transfer Rate** :  
 $\nu_p = \chi \times \eta_p, \nu = \sum_{p=1}^n \nu_p$

(\*) - Governed by the **threshold** : by training

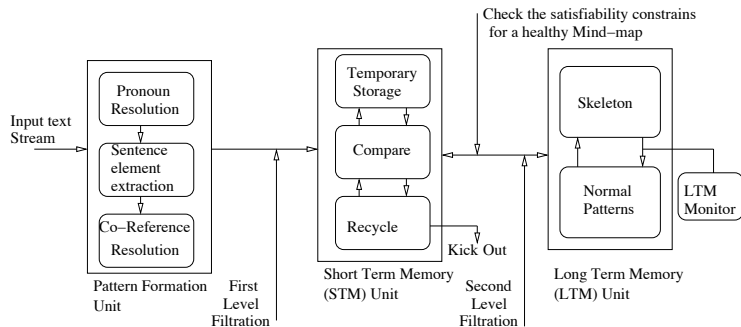
# Membranes



*When same word refer to different meaning  
(ambiguity)*

Identical cells are protected by the membranes

# Basic Architecture

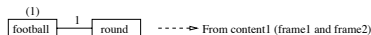
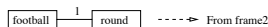
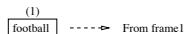


Information Processing

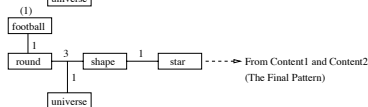
# How it works? : An Example

## Content1 (from Bob):

I have a **football**. The **footballs** are **round**.

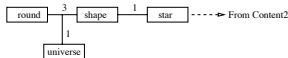
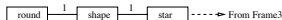
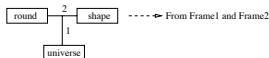
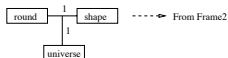
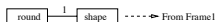


## The Final Pattern (For Alice):

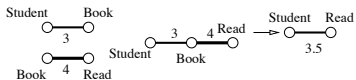
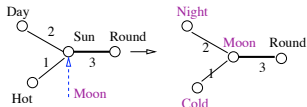
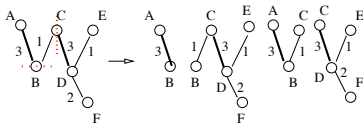
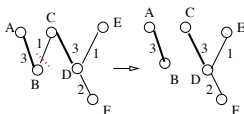
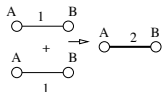


## Content2 (from Bob):

I have mentioned about the **round shape**. The **round shapes** are very common in the **universe**. For example the **shape** of most of the **stars** are **round**.



# Filtration Techniques



Filtration are done as per the satisfiability constraints of a healthy mind-map

- Association (Addition)
- Partition (By Connection)
- Partition (By Node)
- Complementation (Negation)
- Transitive Re-ordering

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# Mind Theory and Mind-Map

## Mind-maps are motivated by the normal thought process of human brain

- Goal : Find out some machine-learning algorithms which simulate the human mind
- Question 1 : What are minds made of?
  - Answer - Tools for thinking
- Question 2 : How does the tools work?
  - Answer - A highly sophisticated **information processing system**. - Not yet known
- Question 3 : Then why this is interesting?
  - Answer - As a computer scientist, we are interested about the techniques (may be that is not exact) and its applicability
  - **Aboutness (Subject)**
  - **Content (Pattern)**
  - **Consciousness (Cognitivity)**



**Mind Theory** : Though unknown we are interested about its **analytical techniques**

**NOTE** : The components inside the Human Brain and Computer are completely different. There are very few similarities between them.

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# Issues for Computational Trust

Problem : The measure of trust is **highly indeterministic**

- For Trust : We are considering the **match situations** between two knowledge states
- Trust may highly influenced by ...
  - **Personal Interest**
  - **Content (Subject)**
  - **Time**
  - **Relation**
  - ...
- We have to think about the **dishonest** conversational partner
  - The trust computation only based on **evidences** is not safe at all
  - The issue of **co-related evidence** must be noticed

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# Summary

- The explorative mind-map is the representation of incremental and adaptive structured knowledge
- The measure of trustworthiness for conversational text streams
- About the characteristic of a healthy mind-map
- A Mind-map construction Framework
- Some techniques for pattern filtration
- **Future Work**
  - For Healthy Mind-map : Develop more precise techniques
  - Mind theory for Mind-map : Its applicability
  - Implementation of the proposed model
  - Formalize Computational trust

# References



[1] C. Brucks, M. Hilker, C. Schommer, C. Wagner, R. Weires, *Symbolic Computing with Incremental Mindmaps to Manage and Mine Data Streams - Some Applications*, Proceedings of the 4th International Workshop on Neural-Symbolic Learning and Reasoning (NeSy '08); July 2008., Patras, Greece.



[2] J. Golbeck, and B. Parsia, *Trust network-based filtering of aggregated claims*, International Journal on Metadata, Semantics and Ontologies, Vol. 1, No. 1, pp.58-65



[3] C. Castelfranchi, R. Falcone, and G. Pezzulo, *A Fuzzy Approach to a Belief-Based Trust Computation*, Springer Link, 2631:55D60, 2003



[4] J. Poray, and C. Schommer. A Cognitive Mind-map Framework to Foster Trust, The 5<sup>th</sup> International Conference on Natural Computation (ICNC'09). Tianjin, China



[5] C. Castelfranchi, R. Falcone. Social Trust : A Cognitive Approach, National Research Council, Unit of AI and Cognitive Modeling , Rome-Italy



[6] A. Clark : Minds, Brains and Tools , Oxford, 2002



[7] P. Dondio, S. Berret : Presumptive selection of trust evidence , International Conference on Autonomous Agents and Multi-agents System, NY, USA, 2007

# Questions?

Thanks  
to  
All of you

Questions?