

# Cognitive aspects of explorative mind-map and computational trust

Jayanta PORAY

University of Luxembourg  
ILIAS Research Unit - MINE Group

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# OUTLINE

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# Motivation

“... the human brain is unique. It gives us the power to think, memorize, plan, speak, imagine. It is truly an amazing organ.”

*Craig Freudenrich, PhD*

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## Questions

- How does human brain work?
- Until what extent human brain can influence the knowledge representation of the artificial agents?
- How do we structure and represent the knowledge?
- What are the uses of these structured knowledge?

# Motivation



## Mind Maps

What happens in my brain  
when I listen to you?

March 16<sup>th</sup> - April 24<sup>th</sup> 2009

Exhibition by

Hall Rectorat /

Ingo Schandeler

Campus Limpertsberg

Mo-Fr 10am-5pm

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space cultures  
et sport

br.0.08 campus limpertsberg

Source : [www.uni.lu](http://www.uni.lu)

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### Mind Maps : The Artificial Human Brain

- Adaptive and incremental knowledge structure like the human brain
- Composed by cells and connections having cognitive ability

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# Problem

- How do we formalize temporal actor based Mind-maps for conversational text streams?
  - The text streams are *decomposed* into meaningful *relevances*
  - *Identify* the new relevances and *merge* into the memory
  - *Skeletons* : The relevances may establish permanent impression inside the Mind-map

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  - *Skeletons* : The relevances may establish permanent impression inside the Mind-map
- How do we compute the degree of trustworthiness during conversation?
  - Trust is a structured set of *mental state* and *social attitude* towards the other agent
  - Trust may be considered as the matching of two mental states
- How the mind-map parameters and computational trust model can be used for solving real-life problems?

# Human Brain and Mind-map

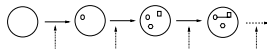


Mind-map is initially empty like the innocent brain of a child

# Human Brain and Mind-map



Mind-map is initially empty like the innocent brain of a child



Mind-map gradually increments with its connection between the temporal patterns

# Signal to Patterned Information



Information inside an input signal

# Signal to Patterned Information



Information inside an input signal



Formation of temporal relevance

(pattern) from the input signal

# Signal to Patterned Information



"The *ideal* of all *education*, all *training* should be the *man-making*"

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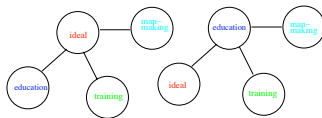
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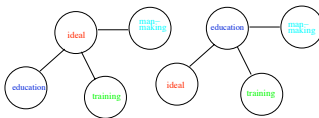
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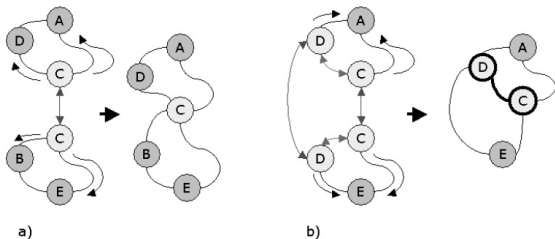
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"The *ideal* of all *education*, all *training* should be the *man-making*"



- Extraction of relevances using *Natural Language Processing* - The *subject cell* and *neighboring cells* with appropriate links
- Apply *Machine Learning* techniques - Sequential pattern matching algorithms (*AprioriAll*)
- Graph theoretic approaches - *Graph partitioning* to improve the overall quality of meaningful relevances

# Activation of the pattern



- New cells and connections (pattern) are compared, then merged with the previous pattern
- More similarity = High activation level

# Skeletons : The selected patterns

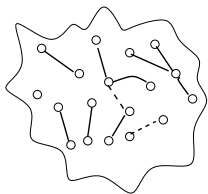
## The Skeletons

- There are some longer established facts or ideas, represent by the permanent patterns
- Those patterns are not influenced by the recent events
- The selected patterns are termed as skeletons, are more important than others

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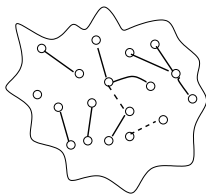


The relevances inside the Mind map

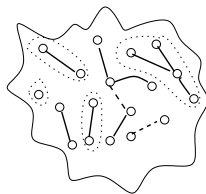
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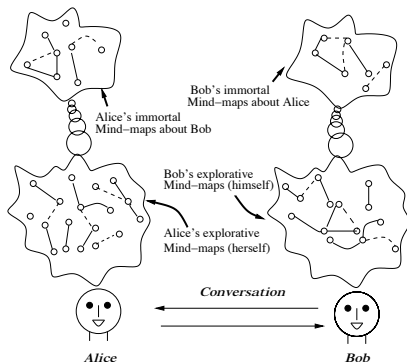


The relevances inside the Mind map



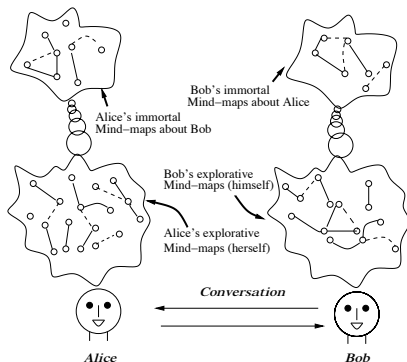
The permanent patterns (skeletons) inside the Mind map

# Conversational Model



Conversation between *Alice* and *Bob*

# Conversational Model

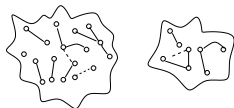


Conversation between *Alice* and *Bob*

## The mental state during natural conversation

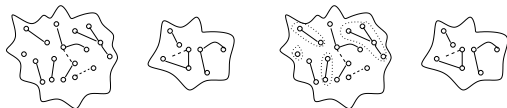
- *Alice* aware about her own world - *Self mind-map*
- *Alice* knows some information about the world of her conversing partner *Bob* - *Outer mind-map*

# Trust by Pattern Matching



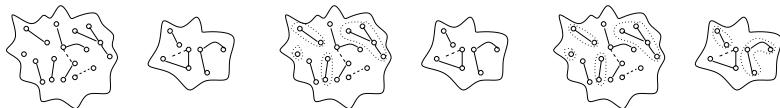
*self-relevances* vs. *outer-relevances*

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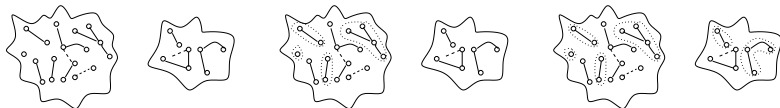


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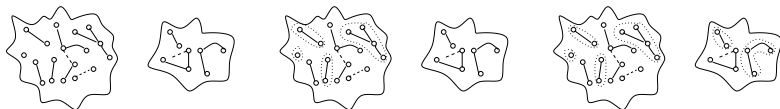
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$$\text{match}(\text{self}, \text{outer}) = \frac{\text{The total number of similarity among the self and outer patterns}}{\text{The number of outer patterns}}$$

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

# Application Area

## Categorization of the incoming e-mails by trust rating

- We consider something more than spam filters to categorize our priority incoming e-mails
- Which e-mails are trustworthy and which are not?
- Which e-mails I need to read first and which I can ignore?
- Which e-mails inside my spam mailbox are not spams?

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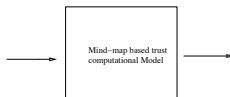
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1	Peter	Paper
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3	Auchan	Advertisement
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The proposed mind-map model

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# Summary

- Mind-map is the representation of incremental and adaptive structured knowledge
  - Works like an artificial human brain
  - Find and extraction of the temporal patterns from the incoming conversational text streams
  - Mind-map merges with the new cells, form a new mind-map with several activation level
  - For Design : Natural Language Processing, Machine Learning and Graph theoretic approaches
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  - Application : Categorization of the incoming e-mails by trust rating
- Future Work
  - Mind map : Improve the cognitivity level
  - Complexity of the mind-map : size and content
  - More specification on computational trust using Mind-map
  - How do we find balance between the trust and reliability for an artificial agent?
  - Design and practical application of the proposed mind-map model

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