Comparison of a Hierarchical Tree to an Associative Map Interface

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Overviews

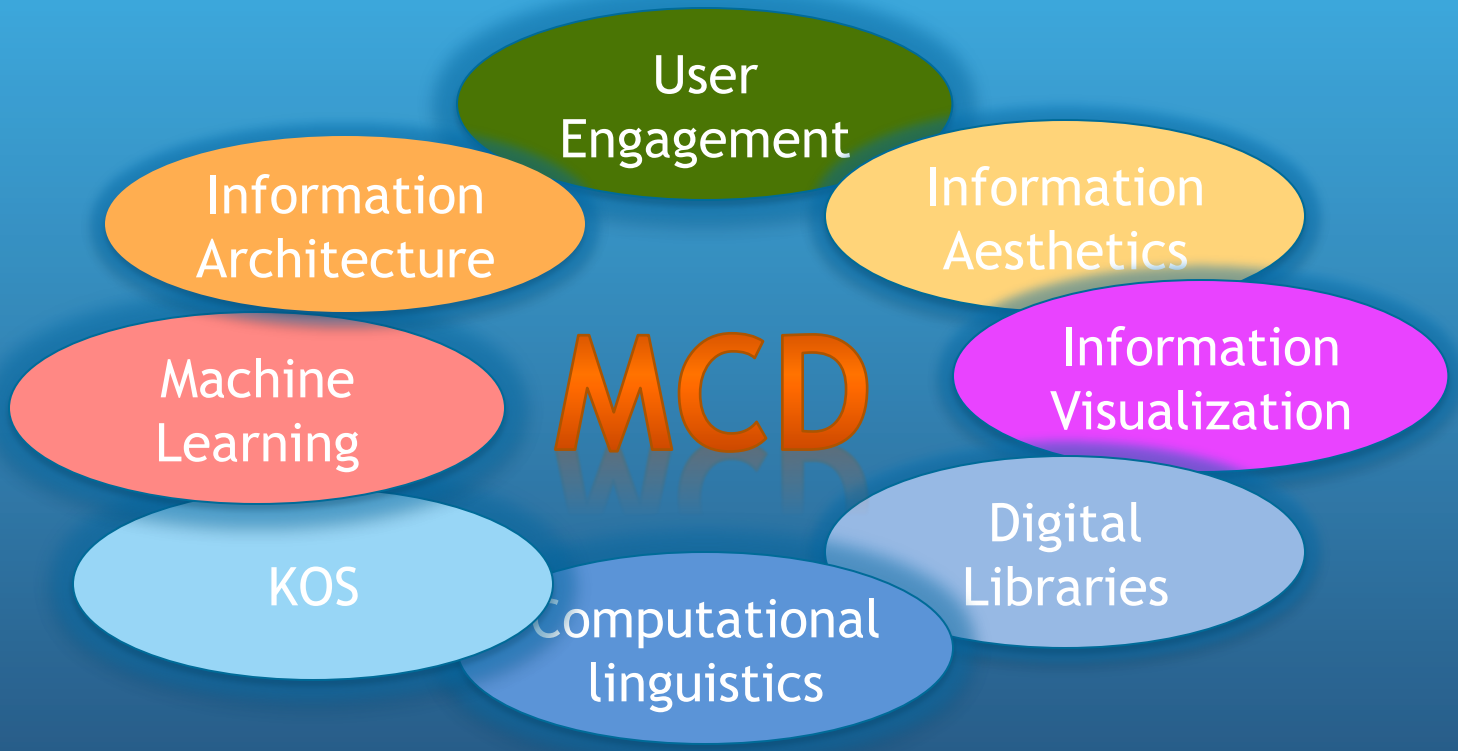
- Background: Meaningful Concept Displays (MCD)
- The interfaces: hierarchical vs. associative
- The experimental design
- Results and discussions
- Conclusions

MCD – Meaningful Concept Displays

- Concept displays need to be meaningful, beautiful, and useful
  - To visualize concept and content structures faithfully.
  - To help users understand semantic relationships of concepts and develop new insight of the relationships.
  - To assist users in selecting concept terms for indexing, querying, browsing and information access.

MCD – Meaningful Concept Displays

- It is a grand challenge to define and build real MCD!



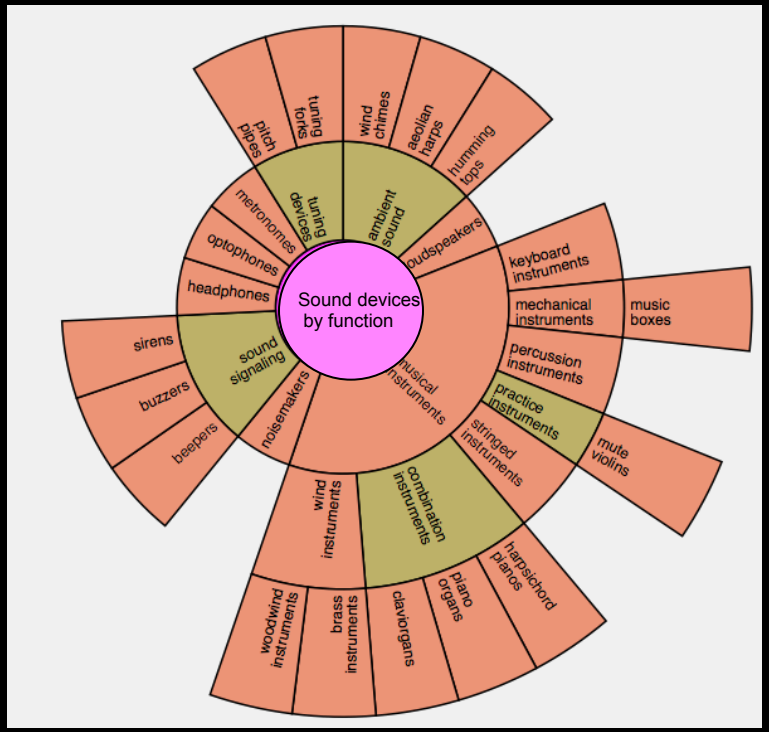
Towards MCD

- Step 1: Setting the Foundation
  - Universal Database structures for concept mapping
  - APIs for concept displays
  - Mapping algorithms
- Step 2: Experimenting with various interfaces
  - Visualization and visual interaction are the keys.
- Step 3: Testing and evaluating different interfaces
  - User experiments are essential.

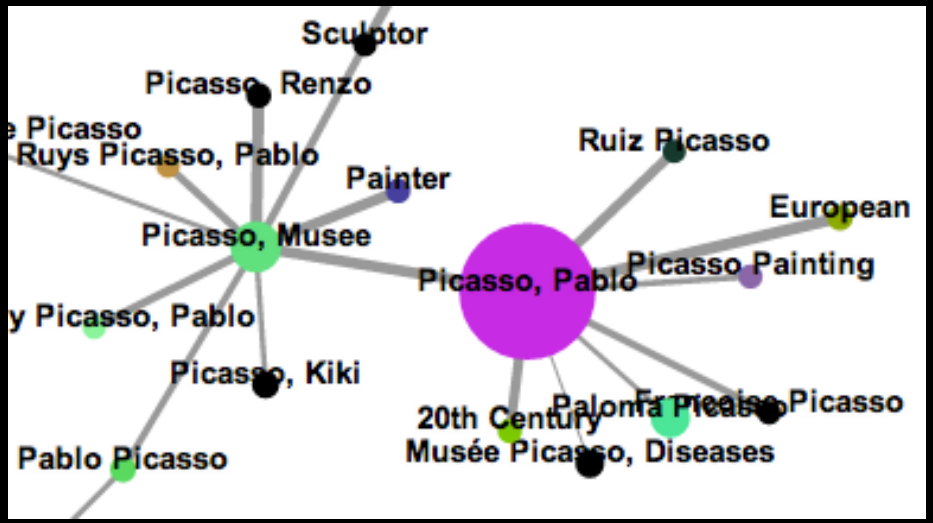
Experimenting with various KOS and interfaces (1)

- Getty AAT Concept Explorer Interface

Global View

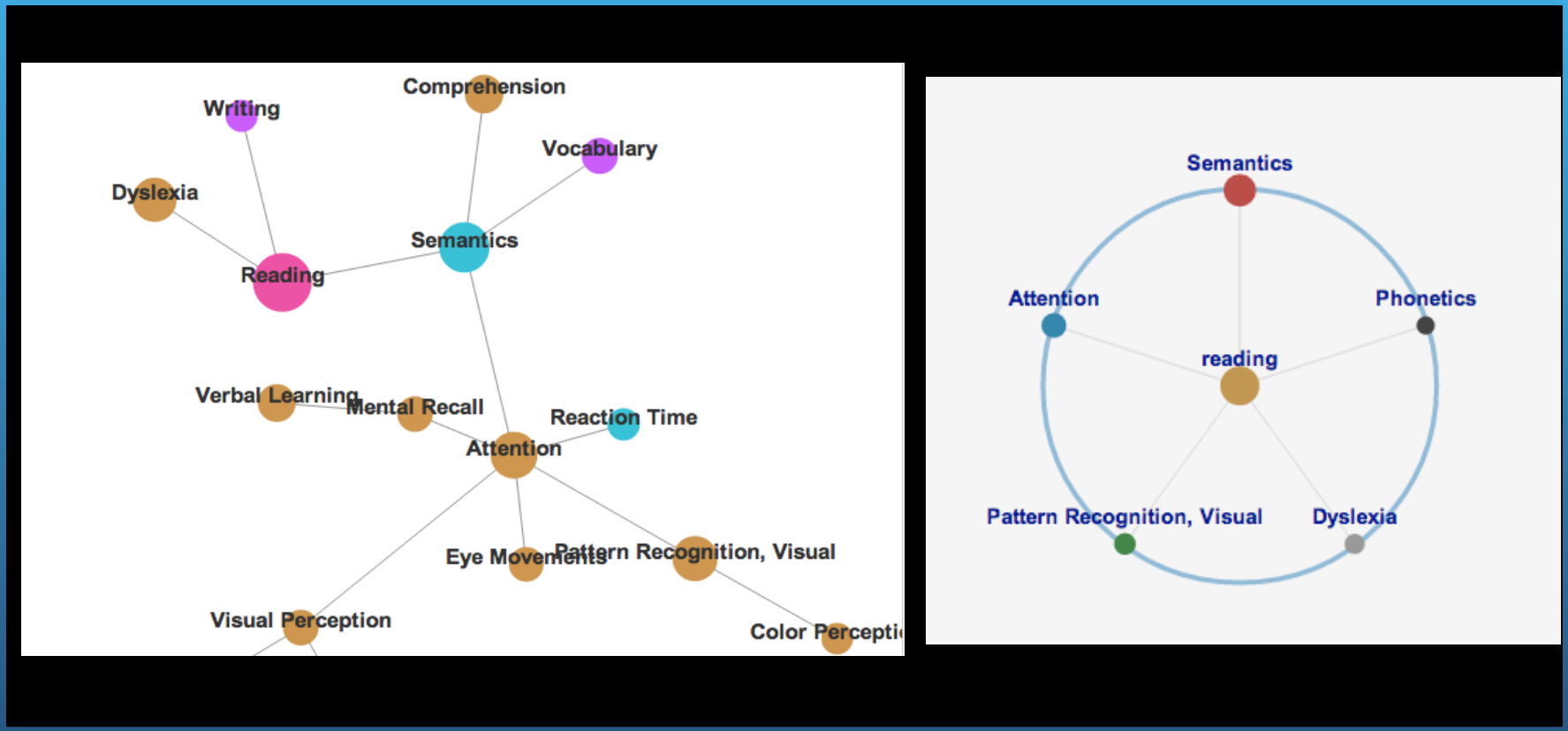


Concept View



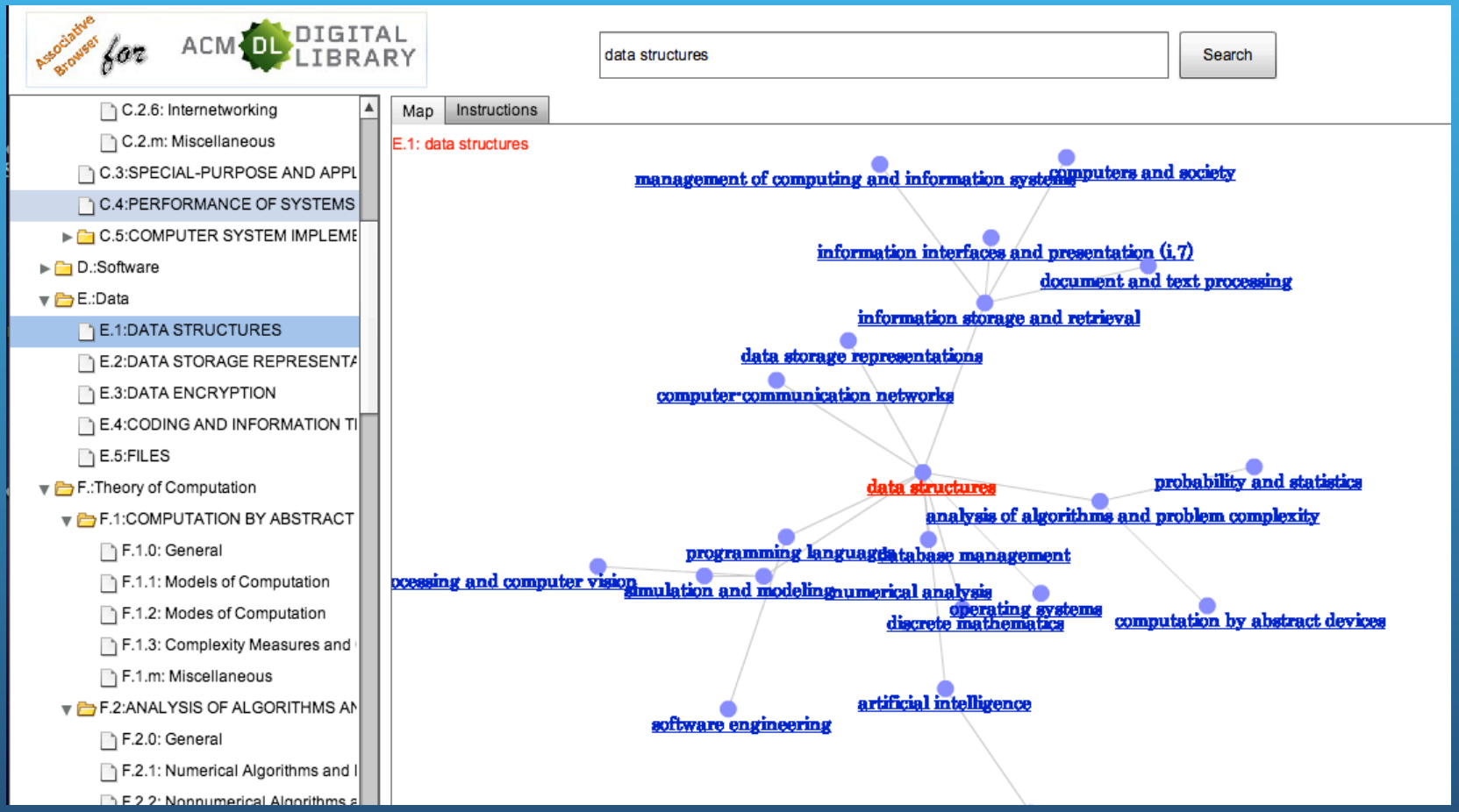
Experimenting with various KOS and interfaces (2)

- UMLS Visual Concept Explorer (displays for concept “reading”)



Experimenting with various KOS and interfaces (3)

- ACM Classification Systems Explorer



Hierarchical Tree Interface

- Advantages
  - Easy to use
    - Familiar and Everyone knows how to follow it
  - Strong grouping/subgrouping
    - Items are logically divided into hierarchical branches and levels.
- Disadvantages
  - Some related terms might be far away in different branches of the hierarchy.
  - It might be difficult to choose a main entry to browse, and if the main entry is not correctly chosen, it might take a while to get to the destination.

Associative Map Interface

- The map interface shows a chosen term and its top 20 related terms in a network style based on the following:
  - The related terms were selected based on the co-occurrence counts of all the 10 years of ACM literature (1999 to 2009).
    - The top 20 term that co-occurred most-often with the chosen term was selected.
  - The matrix of 21 by 21 co-occurrence counts was simplified by a Pathfinder Network algorithm and the result was sent to a graphical layout algorithm for display.
  - The map is generated dynamically each time when the user clicks on a term on either the hierarchical tree or the map.

Associative Map Interface

- Advantages
  - More types of relationships can be displayed.
    - Hierarchical, associative, semantic, and others.
    - Machine learning was used to simplify the relationships.
  - The display is more flexible.
    - Terms of different levels or branches might be brought together to show their relationships.
    - Space, distances, links, shapes, sizes, colors, etc., can all be used to represent various relationships.
  - There are more ways to interact with the displays
    - The map can be generated dynamically in responding to user's inquiry.
- Disadvantages
  - Difficult to understand
  - Difficult to create meaningful layouts that represent the concept relationships truthfully.

The Experimental Study

Comparing a hierarchical and a map interface --

- When asking a subject to choose the best ACM classification terms for a given paper using one of the experimental interfaces
  - Which interfaces help them find terms quickly and satisfactorily?
  - Are the terms selected
    - Consistent among the subjects?
    - Consistent with the paper's classification terms?
  - Are the number of terms selected significantly different from one interface to another?
  - Does the subject prefer one or the other interface?

Study Design

- Randomly assign subjects to either interface
- Have the subject read the first paper and use the assigned interface to classify the paper
- Show subjects both interfaces and have them choose which one to use
- Have the subject read a second paper and use the chosen interface to classify the paper
- Offer the user six-month subscription of either interface and have them chose and explain the reason for their choice

Papers used in the experiment

- The Virtual Sandbox

The virtual sandbox

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Modern virtual environments are three-dimensional, simulated worlds. Inside of them, avatars live the equivalent of a human life: they walk, talk, and interact with other avatars, thus exposing what is considered to be social behavior. As a result, virtual worlds lend themselves to the study of social behaviors in a laboratory setting. In fact, their technical capabilities provide a number of advantages over real life experimental laboratories. On the downside, however, virtual worlds also add complexity to experiments by clouding the identities of the people who "play" the role of their avatars. Despite these issues, virtual environments can contribute to future experimental research by addressing three generic needs that information systems support: increasing social presence, offering an elaborate visualization tool, and providing a safe haven for simulation, exploration, and innovation.

Paper: “The virtual Sandbox”

Primary Classification:
A. General Literature
↳ **A.1** INTRODUCTORY AND SURVEY

Additional Classification: D. Software
↳ **D.2** SOFTWARE ENGINEERING
↳ **D.2.6** Programming Environments

H. Information Systems
↳ **H.0** GENERAL

I. Computing Methodologies
↳ **I.6** SIMULATION AND MODELING
↳ **I.6.7** Simulation Support Systems

K. Computing Milieux
↳ **K.4** COMPUTERS AND SOCIETY
↳ **K.4.0** General

Results

- Compare the user's classification terms with the paper's classification terms
  - The distance metric: counting links between the nodes (classifications) in the hierarchy
    - Perfect correspondence: 0
    - Maximum differential (due to original tree): 28
    - Subtract count from 28 so that perfect measure = 28 and perfect miss = 0.

	Paper I		Paper II		Combined	
Category Chosen	Tree	Tree +Map	Tree	Tree +Map	Tree	Tree +Map
Average	3.9	5.3	4.2	6.2	4.0	5.5
Variance	2.8	15.4	2.2	17.0	2.3	14.9
Distance (variance)	19 (21)	17 (7)				
Num. of Subjects	7	6	6	7	13	13

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↳ **K.4.0** General

- Subject’s Classification:
  - I.6.3 Applications (6)
  - J.4. Social and Behavior Science (6)
  - K.4.2 Social issues (6)
  - H.5 Information interfaces and presentation (4)
  - A.1 Introductory and Survey (3)
  - K.3.1 Computer use in Education (3)

Observations

- Tree+Map interface seems to encourage subjects to choose more classification terms.
- The performance on the Tree interface has a smaller variance than on the tree+Map interface.
- The choice of terms is very diverse: there was a total of 58 classification terms chosen for a single paper by 13 subjects.

Which interfaces they prefer

- 9 subjects chose the TREE+Map interface
  - “The map compliments the tree by providing additional information”
  - “The map suggests other relate terms that I would not have thought of”.
- 3 subjects chose the TREE interface
  - The tree was easier to follow
  - One disliked the size of the nodes of the map and the other indicated the map did not help classify the paper.
- 1 indicated he preferred neither.

Subjects' comments

- "I like the Tree+Map because it displays relationship of the categories."
- "Most papers fit into more than one classification category. The Tree+Map interface is slightly better for finding the second and third categories -- because it suggests the second-level categories that are the "most closely linked". These are the categories that you might want to scan through after you have found the initial category."

More comments

- “I think that the map portion will enable me to think about and investigate areas that I would not have done otherwise.”
- “The map complements the tree. The tree is necessary and is satisfactory alone, especially when the user is familiar with its structure, and when the scope of the paper is focused. The map can be a beneficial addition to avoid omitting possible categories for broader, multidisciplinary papers.”
- “The tree map made it easier to find relationships between categories. I was able to use it to assign multiple categories to the documents.”

Conclusions

- The map interface provides additional information to the users to allow them explore related concepts and potentially pick up more related terms.
- The map interface is more difficult to use than the hierarchical interface. Subjects struggled with the clarity, meaningfulness, and esthetics of the displays.
- The test is limited due to the small number of subjects and the simple experimental task. Further testing is needed.