TU Informatics

Semi-Automatic Creation of Concept Maps

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Motivation

- Concept maps are a method for the visualization of knowledge and an established tool in education, knowledge organization and a variety of other fields.
- They are composed of concepts and interlinked relations in-between and are displayed as node-link diagrams.
- Concept Map Mining (CMM) is the process of extracting concept maps from unstructured text.
- There are three CMM approaches:
  Manual, semi-automatic, or fully automatic.

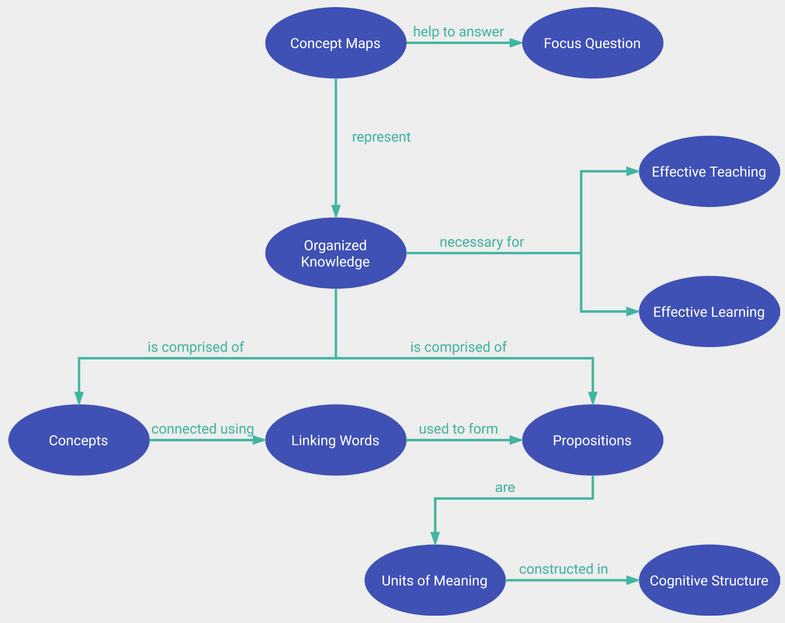


Figure 1: Excerpt of a concept map created by Novak and Cañas [1] that shows the main idea of concept maps.

Problem

- Fully automatic approaches cannot mirror the mental model, which a user would transfer to a manually created concept map.
- The manual process is often perceived as tedious and inefficient.

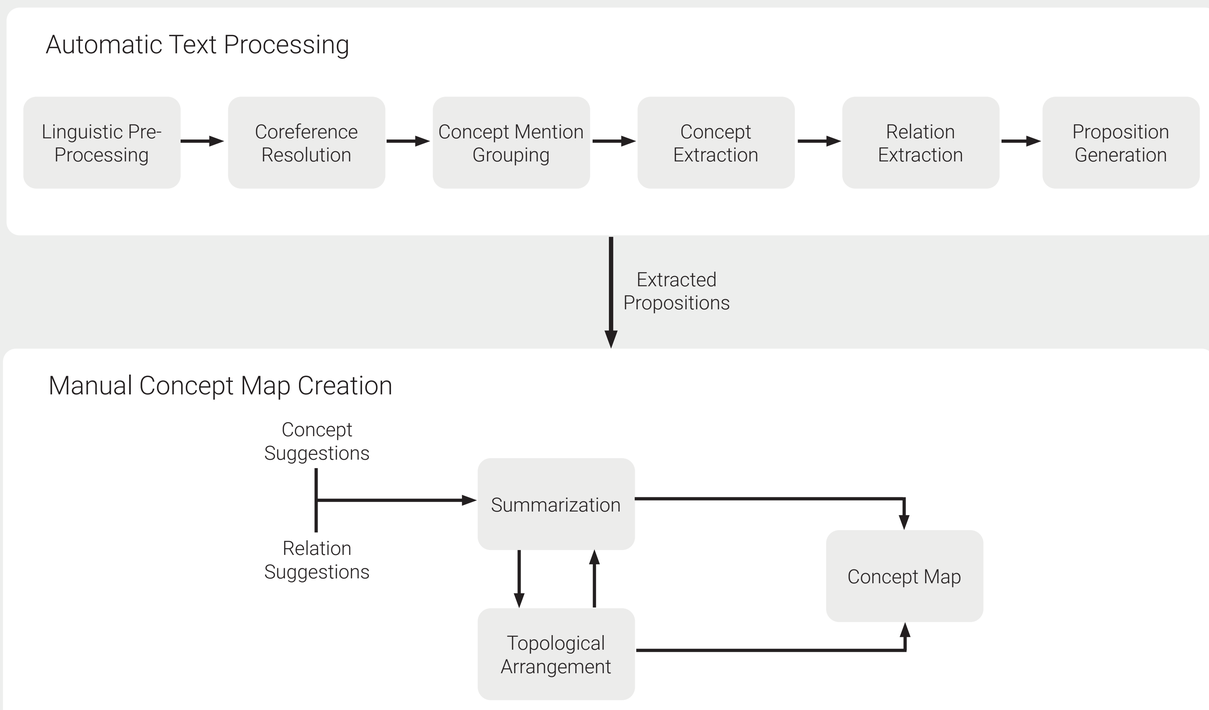
This leads to two hypotheses:

- **H1:** A semi-automatic approach is better in mirroring the mental knowledge model than a fully automatic approach.
- **H2:** A semi-automatic approach is more efficient compared to a fully manual creation of a concept map.

Scientific Method

- Iterative Natural Language Processing and Concept Map Mining pipeline development.
- Implementation of a prototype web application.
- User evaluation with five users.
- Comparison of manual gold standard maps with semi-automatic and fully automatic concept maps created from five texts.
- Qualitative measures: questionnaire, heuristic evaluation.
- Quantitative measures: accuracy, precision, recall, duration.

Semi-Automatic Concept Map Mining



Results

- Concept maps created with semi-automatic CMM approach significantly more similiar to gold standard concept maps than maps created with fully automatic tool. i.e. on average 37% better accuracy.
- Semi-automatic CMM approach therefore mirrors mental model better than fully automatic CMM.
- Semi-automatic CMM considerably more efficient than manual concept map creation.
- On average 27% faster creation duration.
- Overall higher user satisfaction.
- Up to 90% of used concepts chosen from suggested concepts.

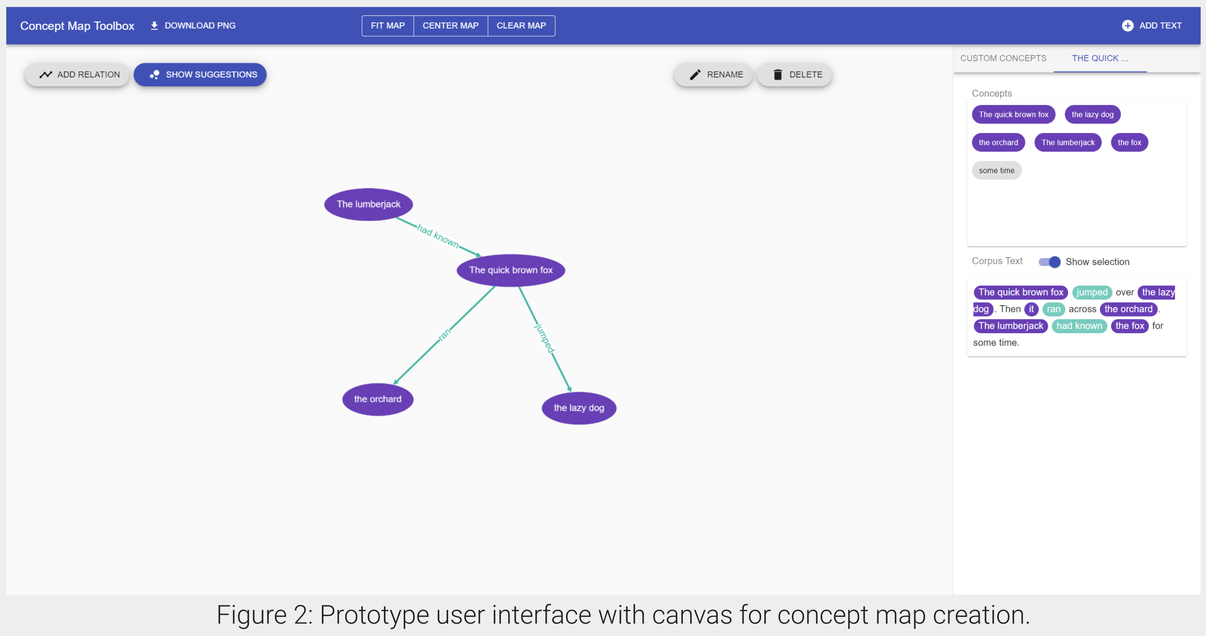


Figure 2: Prototype user interface with canvas for concept map creation.

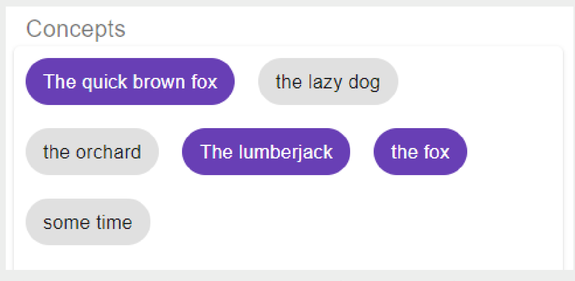


Figure 3: Initial suggestions of extracted concepts.

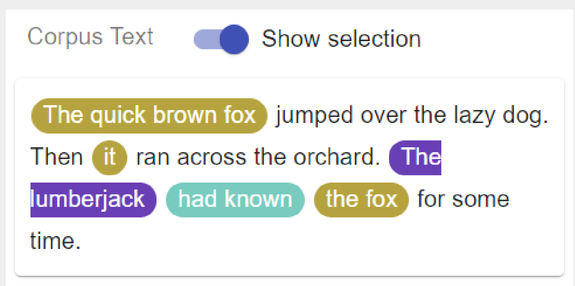


Figure 4: Text highlighting of selected concepts and relations in the text area.

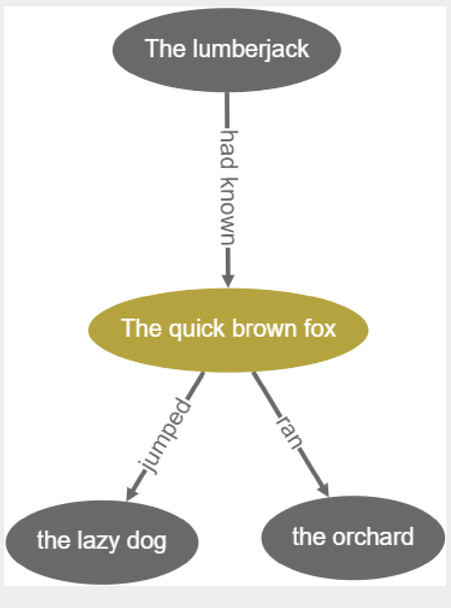


Figure 5: Suggestions for new concepts and relations directly in the canvas.

[1] Joseph D. Novak and Alberto J. Cañas. The theory underlying concept maps and how to construct and use them. Research report 2006-01 Rev 2008-01, Florida Institute for Human and Machine Cognition, 2006.