

## CONCEPTUAL MAPS WRITING: THE CASE OF THE NODES-ARCS

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**Abstract.** The use of conceptual maps representing relations and concepts inside the sentence, necessary to allow their use in writing, implies a problem related with the existence, in the sentence, of tokens that are both concepts and relations: all this considered, we hypothesize the possibility to represent even the relations as nodes, thus differentiating the concept-nodes from those that have the double function of concept and relation: this solution allows a best translation of single sentences in graphs and enlarge the expressive possibilities of conceptual maps.

### 1 1. Introduction

The document's fundamental functions consist in transmission and conservation of the content (Frignani 2003). We can examine from this point of view three kinds of documents: the one organized as recommendations of Semantic Web formalism (RDF, RDF Schema, OWL), the written text and the conceptual map.

The first, included in the XML area, is defined structured because it joins both content and format to structure, that's the connection between data and metadata, typical of database (which don't have format). It's characterized by a mandatory formal rigour, ratified by W3C Consortium Recommendations, in the statement's composition. Every single statement contains a resource, a property and a value, or, otherwise, a subject, a predicate and an object, but it's not directly usable without a style sheet, that, during the processing phase, determines the visual aspect of the document.

The second is formed by a sequential structure of sentences, that are themselves constituted by tokens expressing concepts alternated with others expressing relations between them: the sequentiality implied in the writing, the language's very nature and its evolution, born from common use, leads to substantial impossibility to pursue rigorous expressive formalism, nevertheless we notice that each token is a part of a meaningful assertion, consisting of two concepts and the relation that links them, and moreover that each single concept, set at one extreme point of a statement, may be an assertion itself (in this sentence we find an evident example: the assertion "each token – is a part of – a meaningful assertion" become concept in the assertion "we – notice that – each token is a part of a meaningful assertion").

The third kind of document identifies in nodes and arcs of graph the concepts and the relations that link them, and is build following the fundamental ways of representing expressed by Novak (Novak, 1998), that is the development from top to down starting from the general node-concept, the relations' labeling and their definition through the exclusive use of verbs and connectives. These rules don't determine a formal rigour in the nodes and arcs collocation inside the documental space, even if there is rigour sometimes, in maps' reconstruction on specific software environments.

Owing to the fact that ontology (being's study) means being analysis, that's the analysis of beings' set which this being is logically connected to, and of the relations among them, is evident the analogy among the being, or element, and structured document's resource, written text concept's token and conceptual map's node, and at the same time the analogy between the relation and the property, the relation's token and the arc.

### 2 Designing conceptual maps of sentences

What has been expressed in the short previous introduction can be represented using a conceptual map (see figure 1), in which each relation, connecting two concepts, express a meaningful assertion, that is clearly and unequivocally contextualized inside a map.

In this image, the conceptual map take up the concepts and fundamental relations expressed in the text, but not "each end every" informations that this includes: if we would make up a thorough map of every concept's and relation's token in the text, we find some unexpected difficulties. We look, for example, at a last sentence taken from the previous introduction:

“Owing to the fact ... the relation's token and the arc.”.

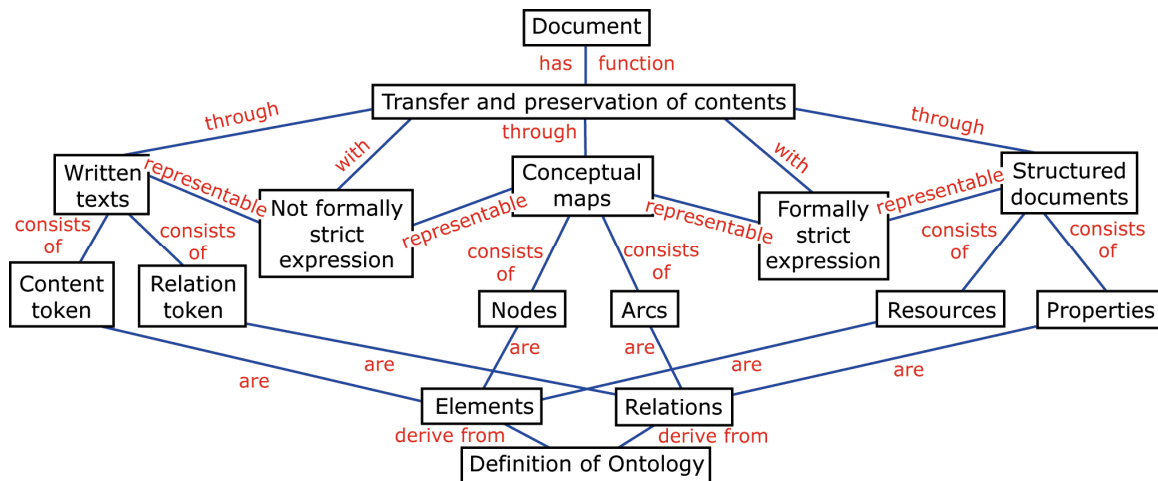


Figure 1. Conceptual map of introduction

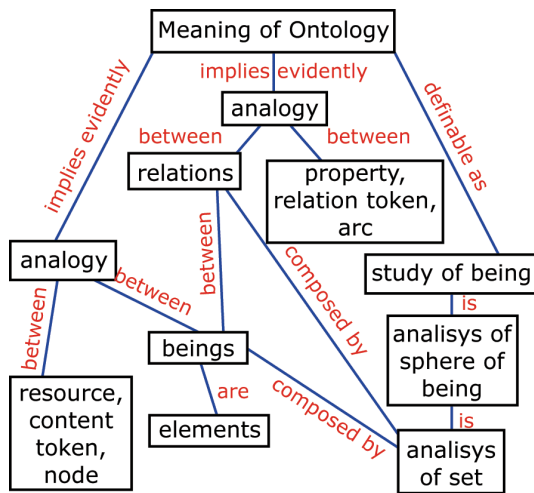


Figure 2. Conceptual map of a sentence

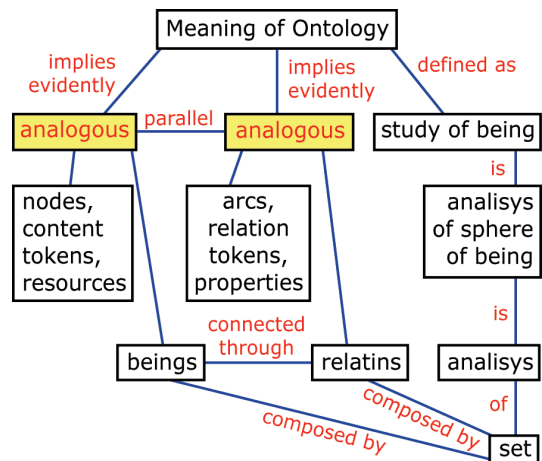


Figure 3. Example of two nodes/relations

We can then try to write it like a conceptual map (figure 2). This first translation is not convincing: the couple of nodes “analogy” and “beings”, connected by the relation “between”, and the couple “analogy” and “resource, content token, node”, connected by an identical relation, don’t express correctly the concept brought up by the text, that would be better expressed by the relation “analogy between” between the node “being” and the node “resource, content token, node”, nevertheless “analogy” is clearly a concept connected to “meaning of Ontology” through the relation “implies evidently”. “Analogy” is thus at the same time a concept and a relation, both in the example held up and in comparison with the cases where a concept become, inside the same sentence, a relation or vice versa. If we had accepted, in the conceptual map’s context, the assertion “analogy – between – beings”, that, beyond the fact that’s not meaningful, risks to generate misunderstanding in the context, we should create a substantial disjunction between map’s structure and sentences structure, where every single token is set up inside a meaningful assertion, that, in this case, is “the analogy between the being, or element, and the structured document’s resource, concept token of the written text and conceptual map’s node”, or, paraphrasing, “being – analogous to – resource, concept token and node”: from this it would derive the impossibility to consider conceptual map as a writing form. We can thus try another way to represent this particularity. In the second representation (figure 3) the “analogous” nodes are even the arcs that link both couples of nodes “nodes, content token, resources” and “beings”, and “arcs, relation tokens, properties” and “relations”: this double nature is on the one hand heretical as regards the axiom of conceptual maps which settles the rigorous biuniqueness in the relations node/concept and arc/relation, on the other hand, corresponding to the real function of the term “analogy” in the examined function, that, paraphrasing, tells that “the meaning of Ontology – evidently implies – two analogies” and “the beings – are analogous to – nodes, concept tokens and resources”, and more “the relations – are analogous to – arcs, relation tokens and properties”.

### 3 A different way to design conceptual maps of sentences

We can analyze an other simply structured sentence, which is interesting owing to the existence of concepts/relation (Pedroni, 2004): “The XML document is structurally comparable with a database, because the connection between the datum and the tag-metadata correspond to, within a database, the connection between the datum and the relative column’s name”. Without any doubt, the conceptual map reproduced in figure 4, which draws the tokens that are in the sentence, highlighting relations and concepts, is structurally mistaken and thus not meaningful: to prove it, it’s enough to observe the statement “database – because – relation”, absolutely without meaning, and thus unacceptable.

The map reproduced in figure 5 is correct from the meaning point of view, but the trick to incorporate assertion inside macronodes implies as a consequence, quite unacceptable, that this map is not a graph. On the other side the trick repropose, in graphical terms, how to overtake this problem allowed by RDF structured language. In this language, the assertion “A IMPLIES B”, where A is a resource, IMPLIES is a property and B a value (that in turn can be considered a resource), is in its turn, a resource, therefore the assertion “C TELLS-THAT A IMPLIES B” results composed by the resource C, the property TELLS-THAT and the value “A IMPLIES B”.

In this short sentence, we can observe four examples of concept/relation: “structurally comparable”, “correspond to”, and two “relation”. If we apply the representation model that implies the possibility of a double role node/arc, we obtain a map as in figure 6, whose substantial difference, in comparison with the map in figure 5, depends on the replacement of the connection to the macronode with the connection to the macronode’s central relation: the relation “because” is not linked to the assertion “XML document – structurally comparable – database”, but to the relation “structurally comparable”, that becomes a concept/relation. We also observe that in turn a concept/relation, “correspond to”, can link two more concepts/relations, the “relation” quoted above: the same connection, represented in figure 5, originates macronodes’ nested structures.

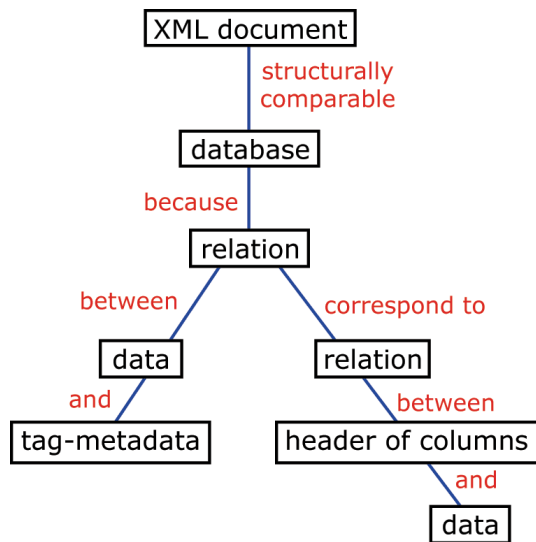


Figure 4. Structurally erroneous conceptual map

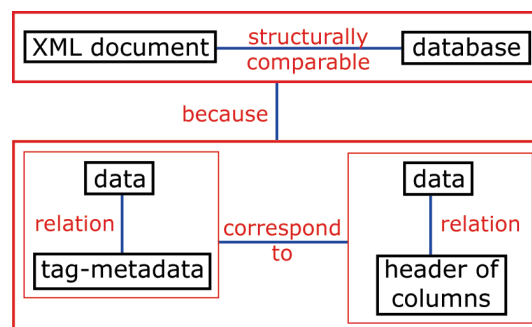


Figure 5. Not-graph conceptual map

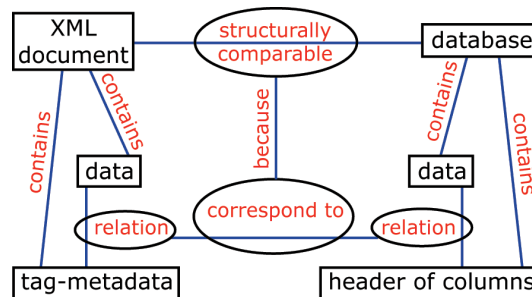


Figure 6. Conceptual map with nodes-arcs

### 4 Conceptual maps as kind of writings

Conceptual maps’ representation using particular elements such as nodes/arcs, aimed at faithfully mirroring common cases of double role concept/relation, as in written language, implies a further consideration: the best adherence to the text let conceptual map advance in the evolution from image to writing innovative form, evolution that is obviously based on the diffusion of this expressive tool, and on the differentiation, sedimentation and sharing of syntactic and stylistic rules, from common use. Many subjects deserve to be dealt

with, in the light of this development: conceptual maps' arbitrary or rigorously formal construction model, the relation with the Semantic Web and the relation with the traditional written text. Consistently with this intervention's topic, concerning the map's use expressing not only knowledge context's macrorelations, but also every single sentence's internal microrelation, is right to point out, in conclusion, the interesting research's corollary: if in text 's translation and localisation processes the biggest problem is not the translation of single headwords and tokens, but the sentence's structural reconstruction, as demonstrated by the decreasing efficacy of available instruments for automatic translation at the increasing text's complexity, writing sentences like conceptual maps, where the structure is made clear in graphical form and it doesn't need a reconstruction (and obviously considering that the meaning of each assertion in comparison with the context is a mandatory rule for map's structuration as in text's sentence), let us overtake from the beginning this problem, using even translation instruments restricted to headwords and short tokens.

## **5. Summary**

1. Introduction
2. Designing conceptual maps of sentences
3. A different way to design conceptual maps of sentences
4. Conceptual maps as kind of writing

## **6. Acknowledgements**

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## **7. References**

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