Metaphorical Cartography for Knowledge Creation and Sharing

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Abstract

In this position paper we discuss the role of geographical metaphors as tools for representing, organizing and accessing heterogeneous shared information, typical of the Web 2.0. Metaphors represent concepts and relations of a knowledge domain with symbols taken from another domain, usually simpler and more immediate to understand. The paper discusses issues related to the use of metaphorical cartography for creating and sharing knowledge.

1. Introduction

The most visible difference between the old world wide web and the so called Web 2.0 is the progressive fading of separation between information producers and consumers, that mimics the lack of distinction between writers and readers in the historical Ted Nelson's vision of hypertexts [6]. As in classical hypertexts, the problem of finding the right information or the right document is central in Web 2.0; users have different attitudes towards information organization and classification, stemming from individual needs and experience, hardly fitting rigid and predefined conceptual schemas.

Indeed, Web 2.0 is only the most recent and evident scenario in which heterogeneous shared information plays a central role. The issues we shall discuss in this paper apply as well to collaborative systems, cooperative design environments, social communities, etc. In such scenarios a problem arises for an author: how to organize the knowledge being produced, and how to describe it to other humans so that the knowledge can be shared with them and they can be engaged in the process of knowledge production. One possible solution is to identify a metaphor [2]; to this end, two points should be considered.

First, humans grow and live in a common real space. They all experience reasoning and representing space to survive [4]. All users experience movement in real territorial space, moving around in their daily life; they experience the difficulties of climbing a mountain or the fatigue of covering a long distance. Quoting Kuhn, "space is fundamental to perception and cognition because it provides a common ground for our senses as well as for our actions ... space is not just any domain of experience, but the most important one, and as such uniquely qualified as a metaphor source" [5].

Using a map, a description of a territory to move in, is also a common experience: this experience is however mediated, and depends on the culture, technical skill and ability of both the author of the map and the user. The history of cartography shows how the progress in science and discoveries has produced maps that are not only more complete and accurate in the Earth representation, but also more apt to address specific goals, due to users agreement on symbols and conventions. On the other side, most of the difficulties in interpreting ancient maps come from the gap between the historical and cultural environment of the map designer with respect to the archeologist discovering them Figure 1 shows a Babylonian world map of 600 b.C. on the left, and the archeologist reconstruction on the right. The interpretation rised from archeological findings [1].

Second, technology makes new tools available: the emergence of geoweb, offering users new possibilities of

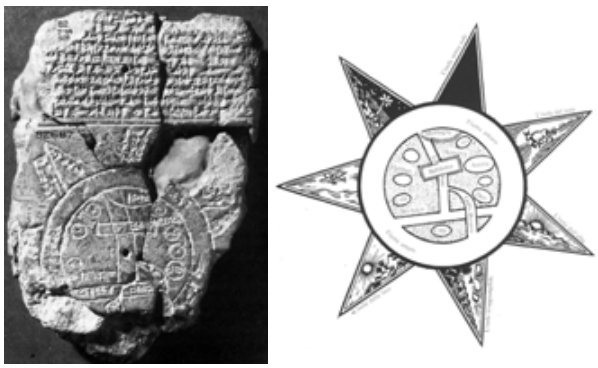

Figure 1. A Babylonian world map (600 b.C.) and the archeologist reconstruction.

interaction and knowledge creation and stimulating the rise of new user capabilities. Web services such as Google Maps enable people to add content to a map and to share it.

In the Web 2.0 world maps have become one of the favorite means to represent information placement. As geographic maps permit the understanding of a land, helping people to understand the spatial relations in it, to move and to meet, hence to communicate, abstract and metaphorical maps permit understanding of a common semantic domain, communication and sharing of knowledge.

2. The raise of a new metaphor

In the past, the metaphor of knowledge as a territory and the use of maps as a new medium for representing knowledge organization became widely popular [2]. Knowledge can be represented as a territory populated by information items, identified by metaphorical landmarks that people recognize based on common sense, human experience and specific cultural biases. Maps become the boundary objects for people to discuss on knowledge evolution.

In the digital world, maps evolve from mute displays of a geographic reality to digital interactive and pro-active tools, whose content develops in time and whose physical appearance can be determined on the fly at use time. Users themselves may become (co-)authors of the map, directly contributing to its evolution. Maps become the medium to update and enrich knowledge.

The basic idea is to mimic the old technique of mentally associating knowledge to spatial and geographical entities to remember and retrieve its chunks [8]. In analogy, knowledge is organized as a virtual geographical space but now stored in a system outside the mind. Digital tools allow users: a) to organize their growing knowledge as a virtual space, b) to communicate this organization to other humans as maps representing the virtual space from different points of view, and c) to contribute new content to the space, hence to the map.

A human can thereafter guide other humans in the exploration of stored knowledge organizing trips through the space, described by tracks on the map, commented by texts (narrations) illustrating the different fragments of knowledge being visited and their properties.

If we focus our attention to bi-dimensional maps that can be viewed using a standard web browser, we can count a huge number of proposals, from the well-known Google Maps to other interesting alternatives [11, 15]. The reasons for such a success stem from the need of a shared classification of knowledge, from the evolution of the web and of the devices toward mobility and ubiquity, and from the user participation.

Knowledge classification. In a situation where people use different personal schemes for classifying an ever-growing amount of information a geographically inspired representation can be seen as a stable and sharable representation of classification methods, being strictly associated to the physical concreteness of the human being and of the territory where he/she lives.

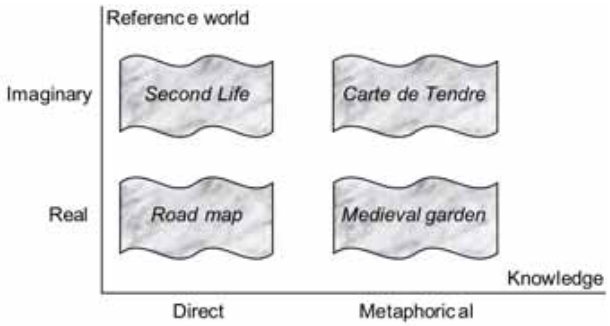

Figure 2. The map classification space

Mobility and ubiquity. In the Web 2.0 age the role of mobility with personal devices is greatly increased; people appreciate the possibility of having appropriate information associated to the location they are currently visiting.

Role of the users. As stated in the introduction, the difference between the information producer and consumer is fading. New hardware and software devices allows users to produce information, to associate it painless to the geographical location and to share it with other users.

3. Between reality and metaphor

We go a step further, and distinguish between a symbolic, thematic annotation of a real land, and a metaphorical representation of knowledge mapped through the symbols of geography; the two representations are end-points of a continuous range where classification is fuzzy, and combination of realistic and metaphoric elements can co-exist.

Figure 2 displays such end-points on the horizontal axis. The label *direct* denotes the case where the map components denote the properties of real objects having a specific location on the territory. The label *metaphorical* denotes the case where the map components are mapped to objects and concepts that are not located on a land, but may benefit from a representation based on similarity with land features. The vertical axis is related to the type of world making the map basis; *real* and *imaginary worlds* can be used as territories on which the map is drawn.

While the plane defined by the two axes can host a continuous range of map types, Figure 2 displays four cases deriving from the combination of the two end limits.

The *Map of Second Life* [12], the artificial world where people may meet in a virtual land using a virtual counterpart, is a good representative of imaginary worlds; most of

Figure 3. A metaphorical medieval garden

Figure 4. The Map of Tenderness (English translation)

the map contents are not metaphorical, because they represent objects of the virtual land, such as a (virtual) building.

The Road *map* is the classical example of direct representation of a real world, whose goals is to assist travelers by showing them a symbolic scaled representation of what they are seeing (or will see) when moving in the real environment.

The map of a *medieval garden*, the so-called *hortus conclusus* (Figure 3), is anchored to the real world, but the elements pictured have a metaphorical meaning: the well, the fountain or the tree placed in the garden center represents the tree of life, i.e., the source of knowledge; the four paths that divide the garden enclosure in four quadrants represent the four angles of the universe. The garden is therefore a metaphor of the universe and of the spiritual life, even if represented through concrete land objects.

The *Map of Tenderness* shown in Figure 4 (*Carte du Pays de Tendre* in the original French version) is the first and best known of a series of metaphorical maps representing an abstract domain [7, 13]. It appears in a novel written by M.me de Scudéry in middle XVII century, and represents the "stations of love" along a path of increasing degrees of affection. The path starts at the bottom of the map in the "*New friendship*" town and leads to tenderness through a smooth river and straight paths crossing small villages, each representing a good feeling. The path is also populated by dangerous feelings to be avoided, such as the forbidden "*Rock of Pride*", leading to adverse moods like *indifference* and *enmity*, represented by a lake and a sea at the two sides of the map. The metaphor is impressive on the emotional side; we shall discuss it in some detail in the next section.

Metaphorical maps, located in the upper right quadrant of Figure 2, are in our view the most interesting ones, since they match the human ability to perceive space and environment with the relations linking entities and concepts in the represented domain. Knowing the composing elements of the map (the base vocabulary of the metaphor) and their layout we are able to interpret the knowledge subsumed by the geographical metaphor.

The correspondence between a representation and the represented knowledge, however, can be satisfied at different degrees; consequently the interpretation of the metaphor can be more or less easy and safe, as art and literature (mainly the classical poetry) put into evidence. To cite a simple case, Dante's *Comedy* is full of metaphors and allegories that have engaged critics for centuries, in many cases without coming to a common interpretation.

4. Metaphor structure, definition and interpretation

A metaphor relates two different words, in the case of our interest a domain of knowledge and a geographical one, with the aim of clarifying some aspect of the first through the features of the second.

The entities of a knowledge domain are classified in *concepts* and *relations*. Concepts can be organized in classes that represent their common aspects.

The author of the metaphor establishes a map from the concepts, classes and relations of the knowledge domain into elements and relations of a geographical space. The association is established because the author identifies some features of the geographical element as explicative of some feature of the knowledge element, he wants to highlight. To represent his view, the author represents the metaphor representing the metaphorical geographical space as a map, drawn following a set of abstraction rules. However, the name attributed to a map entity is the name of the knowledge domain entity associated to the geographical entity being represented. A reader of the map interprets it by first trying to associate the map element to geographical entity and then to derive the author view on the original knowledge domain entity. We discuss an ex-

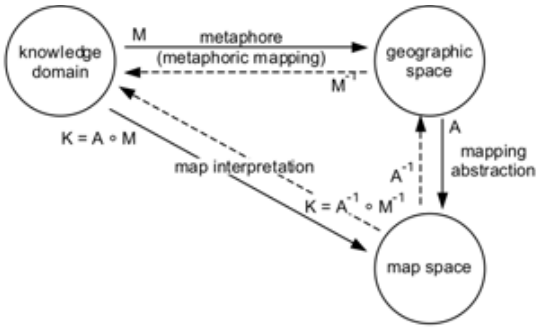

Fig.5 metaphorical map construction (solid lines) and interpretation (dashed lines)

ample to clarify these processes.

4.1 The metaphor of the Map of Tenderness

According to M.me de Scudéry's view, in the knowledge domain of love and affection, examples of concept classes, concepts and relations are:

Concept classes and instances

cause of tenderness (*disposition*, *esteem*, *gratitude*)
origin of tenderness (*new friendship*)
good feeling (*kindness*, *submission*, *attentiveness, ...*)
bad feeling (*negligence*, *inequality*, *oblivion*, ...)
obstacle (*pride*)
tenderness (*tender by disposition*, *tender by respect*, *tender by gratitude*)
failure (*enmity*, *danger*, *indifference*)

Relations

cause of tenderness flows from *orgin of tenderness* to *tenderness*
cause of tenderness leads to *tenderness* through *good feeling*
cause of tenderness leads to *failure* through *bad feeling*
good feeling connects origin of *tenderness* to *tenderness*
bad feeling connects origin of *tenderness* to *failure*

The author associates concept in this domain with geographical entities to express her view on each concept or relation. In her vision, the *tenderness causes* flow across increasing feelings, leading from a new friendship to three types of tender, three different affection states. *Tenderness causes* have a behavior similar to a flow of water, a river, while the different affection states are represented by solid, large cities where the evolution of feeling may stop for a while or forever . Some feelings are smaller cities, which are not meant as destinations but as intermediate steps leading to tenderness. Indeed, the disposition river flows smoothly and directly, because natural disposition needs no other feeling to reach tenderness. Gratitude and esteem, on the contrary, are grown by intermediate feelings that increase the tenderness, but also reveal risks to deviate from the right path with bad feelings, leading to indifference and enmity.

Tenderness is the spiritual destination of good feelings, but since the human nature is not only spiritual, it must be controlled, otherwise an excess can lead, through the dangerous sea of senses, to the unknown lands of the passion.

The metaphorical correspondence between concepts and relations in the spiritual domain has a counterpart in the map, as represented in Figure 5. The solid lines represent the process of metaphor definition, the dashed lines the metaphor interpretation.

4.2. Metaphorical map interpretation

Interpretation of a metaphorical map requires an inverse reasoning: an observer looks at the map and interprets the symbol, first relating them to their meaning in a geographical metaphorical space. By interpretation, the observer infer that in the metaphorical space M.me de Scudery conceived a river named Disposition, leading to the town of Tender by Disposition, and two main paths of villages, labeled with names of feelings, leading to Tender by Esteem and Tender by Gratitude. Deviations from the main paths cross villages labeled with names of bad feelings leading to the waters of Indifference and Enmity. In a second step of reasoning, the reader recognizes the original meaning of this scenario, representing the stages leading from a new friendship to tenderness, to indifference or to enmity, according to the feeling expressed.

4.3. A different metaphor built on the same geographical space

A different metaphor on the same land has been suggested by Jean-Luc Michel. In his web site [9] he proposes, rewriting the content of the *Map of Tenderness*, a map of *Research Tenderness* (*Carte du Tendre de la Recherche*), in which the concepts of a sentimental domain are replaced by concepts related to the scientific research: the *Sea of Speculation*, the *Lake of Empirism*, the villages *Demonstration*, *Imagination*, etc., marking the itineraries leading from *New Research* to *Scientific verification* (*Crible de Scientificité*), as depicted in Figure 6.

4.4 Topology and metrics

The quality of representation/interpretation is also influenced by the level at which the metaphor is designed, i.e., by the use of metric and topological properties together with the basic symbology.

At the basic level a map can be read as a collection of symbols, including neither topological nor metric con-

Figure 6. A metaphor about scientific research on the geographical shape of Map of Tenderness

straints. The metaphorical territories are meaningful only for the symbols they contain. This level is not useful to represent knowledge at a usable level, and is sometimes drawn under artistic and emotional perspectives.

At a second level, many metaphorical territories drawn by artists in the past or visible in the Web use topological constraints, e.g., adjacency, with limited presence of quantitative elements often used to compare rather than to measure. Typical examples are the metaphoric political maps frequently used in the 19th century. Such maps embed qualitative knowledge about the diplomacy and the political relations in Europe and in the World in the shape of topological relations among the map components.

The full concept of map includes metric properties as meaningful components of the representation. Spatially quantified relations in metaphors can convey meanings, contributing therefore to design the richest map type. However, translating quantity on a metaphorical plane is more difficult than translating quality. Metrics are frequently and easily associated to thematic maps, because they can relate metric properties with the values of variables. For example, a thematic map might relate the size of a region with the number of children born in the last year, or with the percentage of land covered by woods.

Metaphorical maps consider knowledge in a broader sense; they may use metric properties to give a feeling of the strength or of the difficulty of an abstract concept. For example, the length of a road may be used to give a feeling of the difficulty of achieving a goal. Therefore an important issue is how to let the reader know which are the meaningful relationships for a given map, in order to avoid misunderstandings. The introduction of a legend, explicitly declaring the mapping, is mandatory in many cases.

5. Building and browsing metaphorical interactive maps

Most of the available tools may treat different classes of objects and are focused on specific segments of the scheme of Figure 2: for example a G.I.S. is usually focused on the (*direct*, *real*) case, because it permits to place different classes of vector objects in the real place; on the other side, authors of maps belonging to the (*metaphorical*, *imaginary*) case may use generic tools for artistic vector graphics, such as Adobe Illustrator™.

A relevant exception to this situation can be found in the Google Maps. While most of the maps built with this tool belong to the (*direct*, *real*) case, because they represent real objects represented on a georeferenced map, there are also some notable exceptions. For example, the site *Slurl.com* [12] uses Google Maps to present a preview of interesting locations available in the *Second Life* world, belonging to the (*direct*, *imaginary*) case. Another interesting example is the interactive version of the *MiddleEarth* [10], related to the famous *The Lord of the Rings* novel. The same site permits to visualize *Second Life* locations that have a strong metaphorical meaning and therefore belong to the (*metaphorical*, *imaginary*) case such as the *Palace of Memory* (Figure 7).

Besides, the Google Maps tool may be used also for displaying maps containing objects that have been built with a metaphorical aim and therefore belong to the (*metaphorical*, *real*) tuple. For example, the maze has been often used in the Christian tradition as a metaphorical representation of the pilgrimage to Jerusalem. Most mazes are represented in the pavement of famous cathedrals, such as Chartres, but there also gardens representing mazes that could have been used by religious communities during centuries. A collection of outdoor mazes from different parts of the worlds is available on Google Maps [14].

These examples show that Google Maps, originally conceived as a tool for displaying *real* geographical ob-

Figure 7. The Palace of Memory in Second Life

jects without any metaphorical aim, can be profitably used also for creating and managing metaphorical maps. Its components represent a distilled subset of objects, widgets and interaction modalities that are widely used in the domain of WIMP interfaces.

The adoption of similar components by other Web 2.0 map applications such as Yahoo Maps! and Microsoft Live Search is a confirmation of their suitability by ordinary users, who are not trained in geographical information systems. Therefore, these components should be carefully analyzed as an interesting starting point for the proposals aimed at building interactive metaphorical cartographies in the context of the current WIMP paradigm.

6. Conclusion

Maps are representations of the real geographic space and – through metaphoric mappings – of other domains of human knowledge. They are useful tools to travel in the real world as well as to metaphorically navigate other domains: the travel from *new friendship* to *tenderness* in the map of Figure 4 is a clear example. The rise of new technologies, such as Google Maps and other geographic mapping systems, opens the way to the creation of interactive maps, which become new media for knowledge representation, sharing, navigation and incremental creation.

A relevant issue reserved to future work is the automatic generation of maps on the basis of a well-defined set of relationships between concepts and geographic elements, defined at design time. The mapping might be domain dependent, shifting therefore the expressivity of metaphorical maps from the single item to the class of metaphorical objects related to a specific knowledge area. The final result might include also the generation of the map legend, in order to smooth ambiguity problems that may be associated to the reading of metaphorical maps.

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