Collaborative tagging as distributed cognition*

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The paper discusses recent developments in web technologies based on collaborative tagging. This approach is seen as a tremendously powerful way to coordinate the ontologies and views of a large number of individuals, thus constituting the most successful tool for distributed cognition so far.

Keywords: collaborative tagging, semiotic dynamics, distributed cognition

1. What is collaborative tagging

Without doubt, the most important recent development in the technological support for distributed cognition is the sudden explosion of collaborative tagging sites on the World Wide Web. The basic idea is straightforward. Users can upload or select certain materials (pictures, music files, texts, websites) and associate tags with these materials. The tags can be freely chosen and are similar to keywords. The user can then browse through tags. He can click on a tag and get materials that have been tagged the same way, see 'tag clouds' that graphically represent the popularity of tags, and see co-occurrence relations between tags and thus jump from one tag to another one (Figure 1).

Tagging sites began to appear in 2004, pioneered by the site delicio.us (for tagging websites), and very soon thereafter the site Flickr (for pictures). Collaborative tagging literally exploded in 2005 and is rapidly becoming a standard feature of websites. For example, Flickr went over the course of a year and a half from zero to close to one million users who uploaded and tagged about 20 million pictures. The past year growth rate has been 30% per month (Figure 2). Many additional sites have come on-line covering almost any domain for which there are websites today, including the exchange of scientific information (as the sites Cite.U.like or Connotea, managed by the Nature publishing

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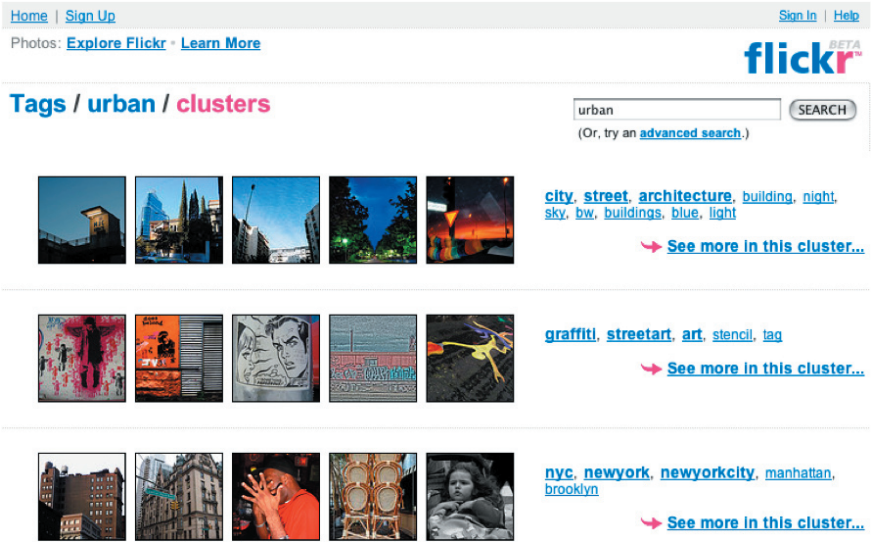

Figure 1. Interface to the collaborative tagging site Flickr by which users can upload pictures and make them available to others. We see clusters of tags co-occurring with the tag 'urban'. The user can browse through pictures associated with each cluster or with specific tags.

group). Clearly collaborative tagging resonates very strongly with human user communities. How can we explain this remarkable development and why is it so interesting and relevant to research on distributed cognition?

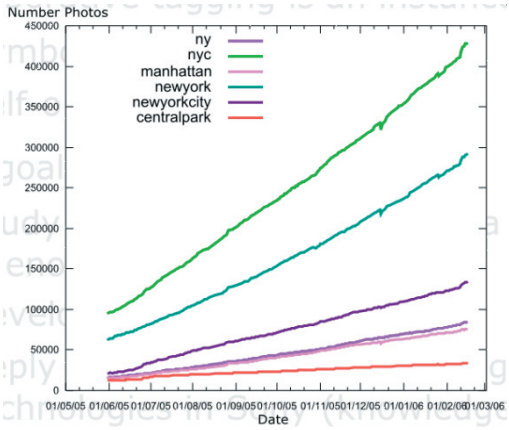

Figure 2. Phenomenal growth rate of pictures tagged with specific tags on the site Flickr for a period of 9 months. The tag 'nyc' went from 100,000 to 450,000 pictures. Notice also how the distribution between tags remains the same despite the scale up.

From a computer science perspective, tags are an alternative to the current URL hyperlinks used on the web. A hyperlink introduces a direct link to another site, and a user can simply click on a piece of text or on a picture and be transported to another site. But the designer of a site must know exactly the location of the link's target (expressed in terms of its URL, the 'Universal Resource Location' address) and the hyperlink itself must be in principle hard-coded in the text itself. This makes such links very precise, which is an advantage. But that can also be a disadvantage because it assumes more knowledge than may be available at the time a site is built and it is vulnerable to disappearing targets. Tagging is much more flexible because the relation between a tag and the address of the resource to which it may point is centrally managed and so new materials can become associated with tags in a distributed fashion. Users can introduce tags without knowing whether and how that tag has been used by others and a tag can attract new links even after it has been introduced by a particular user.

The second advantage of tags is that they introduce a kind of taxonomy of keywords or classifiers, which aid users in browsing by providing meta-data about the contents of uploaded material. So they offer an alternative to search engines like Google which perform search based on information retrieval over the actual contents of a web page. Proponents of the semantic web (Berners-Lee et. al. 2001) have been arguing for years that a new level of meta-data is necessary to carry the web further, but they succumbed to the temptation of handing the design of ontologies to centralised committees and of using logic with its insistence on total formal semantics and definition. Although there is now a sophisticated technology for designing such ontologies and formalisms for annotating websites, the idea of the semantic web has not taken off in practice, mainly because the effort and technological know how needed to design the ontologies is very high and reaching an agreement, even among experts, is notoriously difficult. Real world ontologies are simply too disorganised, fluid, and forever changing to cast into a logical harness. Of course, the semantic web technology is still useful and beneficial in rigid technical domains which are fairly static, like mathematics.

One would think that the freedom implied by open-ended tags would lead to complete chaos or a totally unusable system, but that is not the case. As recent studies that are tracking tag usage over longer periods of time have shown (Golder and Huberman, 2006; Cattuto et al., forthcoming), the distribution of tags for similar items stabilises rather quickly. Apparently a collective consensus arises and is then further maintained despite the absence of any global control. This can also be seen in Figure 2 where the tag 'nyc' remains dominant

against competing tags like 'new york' or 'newyorkcity'. The statistical physicists that have carried out these investigations have argued that this emergent structure can be explained on the basis of statistical models, such as Polya's urn model or the Yule-Simon model, but this does not take into account the cognitive mechanisms and history that users bring to bear on collaborative tagging.

2. The relevance of tagging for distributed cognition

It seems more relevant to see tagging as an example of distributed cognition of the same sort that underlies natural language. For example, the 'tag clusters' reflect priming phenomena well established by psychologists. Just like a word triggers a barrage of other words for related concepts, a tag gets associated by simple co-occurrence with many other tags, and browsing through tag clusters makes sense for users because it resonates with their own associative semantic networks.

Several authors have recently argued that language should be viewed as a complex adaptive system in which a distributed group of agents collectively invent and align shared symbol systems. We now even have quite concrete models for this kind of semiotic dynamics, including for symbols that are grounded in reality through a sensori-motor apparatus (Steels 2003). These models should in principle help us to understand certain phenomena seen in collaborative tagging sites (Steels 2006). And indeed, they do. For example, these models show that a lateral inhibition dynamics induces synonymy breaking so that only a single word (or a few competing words) remain for the same sort of meaning. This phenomenon is also seen in tagging sites. Similarly the language game models suggest ways in which symbol grounding can be achieved through pattern recognition and signal processing and concrete experiments to ground tags in the real world are now ongoing that use the same ideas (Aurnhammer et al. 2006).

But collaborative tagging sites also teach us some new, profound lessons about how symbol systems emerge.

Work on the simulation of emergent communication systems so far focused on reference. Agents are motivated to look for and express properties of objects that are discriminating with respect to other objects. Tags are clearly not doing that. They appear to act like future aids for navigation in large information sources and the tagger does not know yet when and how a particular tag will be useful in the future. So we will have to invent other kinds of games

in which navigation is the primary goal instead of reference. Second, tags are clearly not always groundable. When the tag 'nyc' is typed into Flickr, most of the images that are associated with this tag do not appear to have anything to do with New York City. They show for example a dog which has been photographed in an apartment of a friend in New York City. Similarly most pictures tagged 'red' do not show the color red at all. Tags therefore act as something in between symbols that stand for something in the world, and can therefore be grounded through perception and experience, and symbols that are purely used as labels or signposts to aid in navigation.

Today we are still lacking good models of how humans introduce symbols to organise their information spaces, and particularly how their personal choices are influenced by the choices of others. We also lack good models how symbols that were perhaps initially grounded become used as pure detached symbols and take on new meanings. Collaborative tagging is therefore a new rich source of empirical data and an enormous challenge for scientific models of distributed cognition.

Note

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