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Enabling the Cognitive Semantic Web

It's widely acknowledged that using computational ontologies and languages to capture the semantics of web contents has improved machine understandability and system interoperability: nevertheless, "how" this unquestionable achievement in Web Science and Technology impacts on humans is still an (almost) unexplored problem. State-of-the-art semantic technologies can be used to extract knowledge models and automatically reason over data at different levels of abstractions, but how users actually process those semantically enriched data and the extent to which this extra reasoning power extends the *human mind* have been considered only marginal issues so far. It's not just a matter of running socio-psychological experiments to get a sense of human behavior in the semantic *cyberspace*: in principle, if we could understand the way semantic web contents are elaborated and used by humans in their daily activities, we could also replicate those modalities and develop intelligent artificial agents capable of – first – *generally* interacting with humans and – then – *specifically* adapting to a single user's profile (which would be the ultimate goal for a *Cognitive Semantic Web*). When Google returns the correct answer, everyone pretends to ascribe some sort of intelligence to that familiar white page: but, is Google dealing with intelligence (in the human sense) at all? If we want machines to be able not only to reason over an intertwined web of contents, but also to compute and simulate: i) the representations that humans build of those contents, ii) the emotions that can be triggered by those contents and iii) the decisions and the actions performed on the basis of representations and emotions, we need to put humans back in the (semantic) web. Some may object that humans have already been repositioned at the center of the Semantic Web by means of *social networks.* Focusing on emotions – for instance - it clearly emerges that this is not the case: current state-of-the-art rating systems and tools such as the popular "+1" or "Like" buttons are far from exploiting semantic technologies to provide a comprehensive meaningful model of user's experience. Nevertheless, standard vocabularies and ad-hoc specifications like EmotionML provide a powerful infrastructure to represent opinions and sentiments in a machine-understandable semantic format. But, is it just the problem of finding the most suitable *standard* format? I think it's more likely a matter of *complexity*: a representation of user's experience should be built on top of semantic technologies, but it can't *just* rely on overly rigid models of human cognition and behavior: it should be rich enough to describe the experiencing, the learning process, the emotional responses to the environmental stimuli and simulate them, accordingly. Next generation rating systems need to go beyond the trivial positive/negative dichotomy, allowing users to: (i) express a wide range of emotions (ii) easily associate emotions to semantic web formats (iii) share/publish emotional contents in the form of Linked Data (iii). More importantly, those systems should be able to properly interact with the human users. In ten years I foresee those systems 1) crawling the Web, 2) learning the dynamics of the human cognitive processing of semantic contents, 3) adapting and replicating that dynamics by means of continuously interacting with humans. As a matter of fact, the necessary instruments to actuate those conditions are under development, if not already available: high-speed networks and massive computational power for machine learning (e.g., see the Big Data initiative[1]) are boosting semantic technologies and research on combining cognitive architectures (SOAR[2], ACT-R[3], etc.) with various kind of knowledge resources such as (bottom-up) Wikipedia or (top-down) OpenCyc, WordNet, FrameNet, ConceptNet, etc. (e.g., see Dario Salvucci's work at Drexel University[4], Jerry Ball system for NLP processing[5], the FMS group work at Carnegie Mellon University on computational cognitive modeling[6], etc.). In conclusion I think that in 2022 the Web won't be *just* a connected network of semantic contents accessible in a Google-like fashion: it will be an emergent social network of human and artificial *cognitive agents* interacting in a hybrid environment, where the distinction between physical and virtual will be superseded by the very nature of the entities populating it, namely knowledge objects and knowledge agents.

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[1] http://www.whitehouse.gov/sites/default/files/microsites/ostp/big_data_press_release.pdf
[2] http://www.soartech.com/
[3] http://act-r.psy.cmu.edu/
[4] https://www.cs.drexel.edu/~salvucci/publications.html
[5] http://www.doublertheory.com/
[6] http://fms.psy.cmu.edu/