Ontologies of Cognitive Science, using Protégé-OWL

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Introduction

The present paper gives a very short introduction on cognitive science and the difficulty they face today in terms of knowledge management, and presents how we bring a process of ontology engineering into this scientific field. Building ontologies of scientific knowledge in OWL is a crucial asset of contemporary sciences. It has to be done using adapted tools such as Protégé-owl. This is what we do in the field of cognitive science. Indeed, cognitive science is a very heterogeneous field. It is an essentially pluridisciplinary enterprise that regroups knowledge from many scientific fields such as cognitive neuroscience, psychology, ethology, economy, philosophy and so on. In order to bring clarity as well as to provide a theoretical framework for a knowledge sharing initiative on the Internet, we build ontologies of cognitive science, and so, using Protégé-OWL. We edit CogOnto : an ontology that is composed of several sub-ontologies corresponding to the many domains of cognitive science: neuroscience (NeurOnto), psychology (Psychonto), linguistics, and so on. Several elements makes Protégé-OWL the best platform for our project: it manipulates OWL-DL which allow us to edit web processable ontologies. We use DL reasoning coupled with RacerPro to keep our ontologies consistent and test new representational possibilities. As CogOnto is designed as a fusion of several sub ontologies from the field of cognitive science, merging techniques are necessary for us. The PROMPT Plugin makes merging an easy and efficient task.
For all these reasons, a general ontology of cognitive science is now possible. Following section recapitulates the content of a poster to be presented at the 10th International Protégé Conference.

Research summary

presentation: The ontologies of cognitive science project.

Cognitive science is a highly heterogeneous scientific field. Cognitive Neuroscience, psychology, philosophy, linguistics, artificial intelligence, economy, ethology, ergonomy and other sectors participate to it. They altogether address the question of the nature and structures of natural and artificial cognition. Their researches are among the trendiest, their results thoughts-provoking, their applications promising. cognitive science could be a leading science of the 21st century.

Nevertheless intellectual and practical difficulties are linked to the pluridisciplinary character of cognitive science. It makes it a very heterogneous scientific field. ontologies, as a technology to deal with heterogeneity of data and frameworks, are a key tool to manage knowledge coming from cognitive science. Moreover, editing ontologies of cognitive science in OWL sets up the theoretical ground for a semantic web knowledge sharing initiative to be launched in this scientific field. Such a e-science effort would benefit the whole community and enable *e-cognitive science*.

A major part of our research is a knowledge representation process. Cognitive science should be represented using *specific kinds of relations,* that are not the one currently at use in natural sciences: functionalist relations of the form *input, output.* Cognitive explanatory framework is built along these relations since J.Fodor (1983). Therefore, and adopting a *Realistic view* in ontology engineering (B.Smith(2006)) we build ontologies of cognitive science along three properties: is_a, has_part, input/output.

techniques: DL & OWL modelling.

The knowledge representation techniques we employ use Description logics and OWL capabilities. Knowledge resources from the field of cognitive science are represented in terms of individual filling classes related along is_a, has_part and input/output properties. Techniques coming from analytic philosophy and artificial intelligence are employed to model highly theoretical claims as well as well as concrete knowledge into formal languages. It provides us with OWL ontologies and equivalent Description logics formula that we use to present the content of our work clearly.

realization: NeurOnto & PsychOnto models .

The previous techniques allows us to dispose of two ontologies of important scientific domains within the scope of cognitive science: the NeurOnto ontology of congitive neuroscience and PsychOnto ontology of cognitive psychology. Both are made in a compatible way and represents decisive claims in cognitive science. For the first time neuroscience and psychology are put together under a common machine processable formalism. We provide graphical representation of our ontologies using the Jambalaya Plugin.

The merging of NeurOnto and PsychOnto is the first step towards the building of a general ontology of cognitive science (CogOnto) . The advances realized in this direction are definitely promising.

technicals questions and philosophical tracks:

This knowledge representation process brings about a cluster of technical and philosophical questions to be adressed to the ontology engineering and cognitive science community. Questions such as: how can relations at stake in psychology can be adequately represented? How can this knowledge fit with knowledge from neuroscience? They contain a promise of an always better understanding of these fields.

Direction of research:

the *ontologies of cognitive science project* have to extend to areas of cognitive science other than neuroscience and psychology, as well as the grounds for an e-science initiative have also to be defined and presented. Our ontologies already provide a robust indexing technology as a theoretical framework to index scientific data in large databases. Protégé-OWL is a well suited tool to keep working in this direction.

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