

COINVENT: Concept Invention Theory

Ontologies and Semantic Web Technologies for Concept Invention

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Abstract. We sketch how the EU project COINVENT ‘Concept Invention Theory’ addresses the problem of concept invention as formulated within the area of conceptual blending. We in particular discuss the use of ontologies and Semantic Web (SW) technologies within the project, and the potential benefits from technology exchange with other SW projects.

1 COINVENT: The Problem of Concept Invention

The capacity of combinational creativity—i.e., when novel ideas are produced through unfamiliar combinations of familiar ideas—is difficult to recreate computationally. It is hard for autonomous computational systems to tackle the combinatorial explosion of potential combinations, and to be capable of recognising the value of newly created ideas, particularly when they are not specifically sought—this is the problem of creative serendipitous behaviour.

In COINVENT, we aim at developing a computationally feasible, cognitively-inspired formal model of concept invention, drawing on Gilles Fauconnier and Mark Turner’s theory of conceptual blending [1], and grounding it on the sound mathematical theory of concepts proposed by Joseph Goguen [2].

The model will draw from interdisciplinary research results from cognitive science, artificial intelligence, formal methods and computational creativity. To validate our model, we will implement a proof of concept of an autonomous computational creative system that will be evaluated by humans in two testbed scenarios: mathematical reasoning and melody harmonisation.

2 Concept Invention and the Semantic Web

A number of core technologies that will be employed in the overall architecture of our prototypical computational concept invention system are closely related to research issues in the Semantic Web.

Ontologies. The concepts that are blended within the COINVENT project are represented as ontologies, in particular as OWL 2 ontologies, which are serialized both in RDF/XML and in Manchester Syntax.

Ontology repository. We are developing an ontology repository, called Ontohub (see ontohub.org). Ontohub supports more than 20 logical languages for ontology design, among them OWL 2 DL and its profiles, and RDF. The backend of Ontohub is the proof management system Hets, which gives theorem proving support using a variety of proof engines. Ontohub closely follows the linked open data principles and fully supports the OWL and alignment APIs.

Ontology alignment, combination, and modularity. In COINVENT the blending of concepts is implemented by blending the ontologies that represent those concepts. Thus, ontology alignment, ontology combination, modularity, and the formal specification of blending diagrams are critical for COINVENT. To express these operations we develop the Distributed Ontology Language (DOL), which allows to add structuring constructs to typical ontology languages. DOL is part of the emerging Ontology Integration and Interoperability standard (OntoIOP), developed within the Object Management Group (OMG).

Ontology evaluation. Conceptual blending leads to many possible blended ontologies. Typically, only a small subset is interesting or useful. For this reason we apply ontology evaluation techniques to evaluate the blended ontologies; e.g., Ontohub has currently integrated Oops! (<http://oeg-lia3.dia.fi.upm.es/oops/index-content.jsp>)

3 Expected Synergies

We expect strong synergies from knowledge and technology exchange with other EU SW-projects. In particular, the capabilities of Ontohub and DOL should be useful for any EU project which requires an ontology repository or which develops modular ontologies. The Ontohub repository is a hosting repository for the FOIS 2014 ontology competition, and already features in a number of other contexts, e.g. the Ontology Summit 2014, or the Spaceportal.org project. Moreover, the DOL language adds many useful features on top of OWL and RDF that can be exploited in SW applications.

In addition, the COINVENT consortium is also exploring the social dimension of creativity, in particular by exploring the ‘logic of discovery’ as introduced in Imre Lakatos’ famous ‘Proofs and Reputations’ [4]. We are here in particular looking into integrating social SW features into the concept invention workflow (and into Ontohub), and to make full use of other reasoning, modelling, and implementation experiences that other EU SW-projects could bring to the problem of concept invention. Furthermore, we are looking for SW application scenarios where the idea of concept invention and the expressive means of the DOL language could be fruitfully exploited.

The basic functionalities of Ontohub.org and the DOL language, and their current support for concept invention based on ontologies written in OWL 2, will be demonstrated during the session.

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