



Open PhD position for CSC scholarship candidates 2014

<u>Department/Institute:</u>	Computer Science
<u>Subject area:</u>	Computer Science, Artificial Intelligence, Philosophy
<u>Name of Supervisor:</u>	PD Dr. Christoph Benzmueller
<u>Number of open positions:</u>	2
<u>Project title:</u>	Computer-assisted redesign of the SUMO upper level ontology

Project description:

The mechanization and automation of (A) combination of logics, (B) context and (C) expressive ontologies are prominent current challenge problems. Their solution is of significant interest to computer scientists, artificial intelligence researchers, computational linguists and philosophers. Application areas include, for example, logic-based knowledge representation and reasoning, multi-agent systems, the semantic web, and computational social choice.

I propose to approach these challenge topics from an higher-order logic perspective (HOL, Church's type theory [1,2]). From this perspective these topics are closely related and a uniform solution appears in reach. Moreover, off-the-shelf higher-order automated theorem provers can be readily employed for the automation of reasoning with respect to these challenge topics. More information on this research project is provided in [3] and [4].

In the context of these overall research goals, I am seeking for two PhD students who focus on challenge (C), in particular, on the computer-supported redesign of the expressive SUMO ontology [5]. Similar to Cyc [6], SUMO contains a small but significant number of higher-order representations [4]. They are particularly employed for modeling contexts, including temporal, epistemic, or doxastic contexts. In SUMO, for example, a statement like (loves Bill Mary) can be restricted to the year 2009 by wrapping it (at subterm level) into respective context information: (holdsDuring (YearFn 2009) (loves Bill Mary)). Similarly, the statement can be put into an epistemic or doxastic context: (knows/believes Ben (loves Bill Mary)). Moreover, contexts can be flexibly combined and the embedded formulas may be complex: (believes Bill (knows Ben (forall (?X) ((woman ?X) => (loves Bill ?X))))). The close relation to Mc Carthy's approach [7,8] is obvious. A crucial requirement for challenge (C) thus is to support flexible context reasoning in combination with other first-order and even higher-order reasoning aspects, and in combination with relevance filtering in large knowledge bases [9].

The two PhD projects are thus aiming at a systematic, computer-supported redevelopment (including formal verification) of the SUMO upper level ontology. The goal will be to enable a sound and effective treatment of contextual reasoning in SUMO.

The two candidates will work on different aspects, but they will also closely collaborate. The first PhD student will concentrate on the computer-assisted

reformulation of the SUMO ontology. The second PhD student B will focus on the task specific application, improvement and tuning of HOL theorem provers and model finders; they include LEO-II (leoprover.org), Satallax (satallax.com), Nitpick (www4.in.tum.de/~blanchet/nitpick.html) and Isabelle/HOL (isabelle.in.tum.de).

References

1. P. B. Andrews. An Introduction to Mathematical Logic and Type Theory: To Truth Through Proof. Kluwer Academic Publishers, second edition, 2002.
2. A. Church. A formulation of the simple theory of types. Journal of Symbolic Logic, 5:56–68, 1940.
3. C. Benzmüller. [A Top-down Approach to Combining Logics](#), In Proc. of the 5th International Conference on Agents and Artificial Intelligence (ICAART), SciTePress Digital Library, 2013.
4. C. Benzmüller and A. Pease. Higher-order aspects and context in SUMO, Journal of Web Semantics, 12-13:104–117, 2012.
5. A. Pease. Ontology: A Practical Guide. Articulate Software Press, Angwin, CA 94508, USA, 2011.
6. D. Ramachandran, P. Reagan, and K. Goolsbey. First-orderized ResearchCyc: Expressivity and efficiency in a common-sense ontology. Papers from the AAAI Workshop on Contexts and Ontologies: Theory, Practice and Applications, Pittsburgh, Pennsylvania, USA, 2005. Technical Report WS-05-01, AAAI Press, Menlo Park, California, 2005.
7. J. McCarthy. Generality in artificial intelligence. Communications of the ACM, 30(12):1030–1035, 1987.
8. J. McCarthy. Notes on formalizing context. In Proc. of IJCAI'93, pages 555–562, 1993.
9. K. Hoder and A. Voronkov. Sine Qua Non for Large Theory Reasoning. In Proc. of the 23rd International Conference on Automated Deduction (CADE-23), Springer LNAI 6803, pp. 299-314, 2011.

Language requirements:

Information for candidates in which languages a doctoral thesis can be written. If English is possible, please also indicate if in addition German language proficiency is required and at which level.

Fluency in English (speaking and writing) is mandatory; the thesis will be written in English.

German is not required, but very helpful for mastering everyday life in Berlin.

Academic requirements:

Please specify which subject areas are suitable and if a Bachelor's degree is sufficient for a full time doctorate.

M.Sc. or B.Sc. degree in Computer Science (or Mathematics or Theoretical Philosophy). Important is a good background in logic (first-order logic and beyond).

Further information:

page.mi.fu-berlin.de/cbenzmueller/