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JARS-2017 notification for paper 8

JARS-2017 <jars2017@easychair.org> Wed, Aug 29, 2018 at 12:21 PM
To: Christoph Benzmüller <c.benzmueller@googlemail.com>

Dear Christoph Benzmüller,

this message is to inform you that, due to the high number of quality submissions to the Special Issue of JAR on Automated Reasoning Systems, your submission with title

Automating Free Logic in HOL, with an Experimental Application in Category Theory

has not been selected for publication in the special issue. However, based on the positive reports by the reviewers, we have agreed to consider accepting it for regular publication in JAR subject to the revisions suggested by the reviewers.
If you find this arrangement acceptable, please prepare a revised version that carefully addresses the reviewers' comments and suggestions. The reviews are enclosed below.

You will need to submit the final version through JAR's submission site.
Please go to http://www.editorialmanager.com/jars/Default.aspx, login as an author, choose the "Submit New Manuscript" option, and select "Research Article" as the article type. In the comments section, please write the following text:
"Revised version of original submission to JARS special issue,
to the attention of Associate Editor Christoph Weidenbach".

Together with your revised paper, please submit as supplementary material a text or PDF file explaining in detail how you have addressed the reviewers' comments.

We kindly ask you to submit your revised version by October 30, 2018.

Best Regards,

Armin, Cesare and Christoph
Special Issue Editors

----------------------- REVIEW 1 ---------------------
PAPER: 8
TITLE: Automating Free Logic in HOL, with an Experimental Application in Category Theory
AUTHORS: Christoph Benzmüller and Dana Scott

Overall evaluation: -1 (weak reject)

----------- Overall evaluation -----------
In this paper the authors present an embedding from free first order logic into higher order logic (HOL). After proving the correctness of the embedding, they formalise a (slightly different) version of FFOL in Isabelle/HOL. They present various axioms sets and show their equivalence, using Sledgehammer. Finally, they show that the set of

axioms of Freyd and Scedrov implies that all object are existing, but their axiom system can be repaired.

My major concerns are the following:
• this paper mentions a formalisation in a proof assistant, but not all the results are proven within the proof assistant (see the SMT-calls). So this paper is not really about a formalisation.
• this paper heavily relies on Sledgehammer, but fails to properly describes what it does and what is trusted.

From what I understand from the application (Section 4), the authors wrote the axioms in Isabelle, called Nitpick and Sledgehammer, and then concluded that (i) the axioms systems are equivalent (ii) they are consistent. I am not sure that JARS is the best place to present such work. I would at least expect more information on the experiments: some benchmarks about the efficiency of provers (using for example the Isabelle tool mirabelle), more comparison between the system of axioms. How much higher-order is really needed? Are Satallax, Leo-II, and Leo-III able to prove some goals? Is one system of axioms better suited to prove lemmas?

1 Comments

1.1 Question

- is the ⋆ related to Isabelle's undefined symbol?

1.2 Important

- utilize "\usepackage{cite}" to ensure that the numbers are sorted (like "[22,28,23,26]" ~> "[22,23,26,28]")
- use only one numbering for definition, theorems, and lemmas
- if you do not already know what sledgehammer is, you have no change to understand the sentence "The proofs are found by Sledgehammer and verified in Isabelle/HOL". Section 4.4 comes far too late.
- Same for the SMT tactic. Why is it different from the other tactics? What is the tactic doing

1.2.1 Introduction

- "in the mathematical proof assistant Isabelle/HOL": what is the difference between a mathematical proof assistant and a non-mathematical one?
- "our solution can be utilized […] with a while range of other reasoners". I expected the solutions to be the embedding of FFOL in HOL, but you seem to see the formalisation of the embedding as the solution.

1.2.2 Exploring Axioms Systems for Category Theory

◊ 1.2.2.1 Remark on the experiment

- "The above results enable the employment of any theorem prover that supports HOL with definite description to reason with FFOL, including TPTP THF [30] compliant systems such as Satallax, Nitpick, LEO-II and Leo-III"… and in the formalisation you mostly rely on CVC4, E, SPASS, and Z3.
- "In this sense, our Isabelle/HOL verification is modulo the correctness of the smt solvers CVC4 [18] and Z3 [24]." Emphasize that this is *not* the default setup. By default, (i.e., unless you are using smt as an oracle or you are changing the solver used by the SMT-tactic), the smt-tactic replays the z3-proof using the kernel. "The smt method reconstructs Z3's proofs" [Extending Sledgehammer with SMT Solvers, Blanchette, Paulson, and Böhme].

- "trusted/verified tools in Isabelle/HOL": which tools are "trusted"? (not SMT)

1.3 Typos

1.3.1 Introduction

- "but *is has been* considered as rather unsuited": is or has been
- "we reveal a technical flaw: either" (not capitalisation), but on p8 "(remember that FFOL domains D […]): Let g be a variable assignment for FFOL"

1.3.2 Preliminaries

◊ 1.3.2.1 Free Logic

- "these basic assumption are abolished": assumptions (plural)
- Definition 2: "E ⊆" ~> "E ⊂ D" (since ⋆ ∈ D \ E, the equality is strict)
- Definition 4, "||s_o||^{M,g} = T": True instead of T?

◊ 1.3.2.2 Classical Higher-Order Logic

- (footnote p6) "LEO-II [12], Leo-III [11] and Satallax [16].": missing Oxford comma ", and"

1.3.3 Shallow Semantical Embedding of FFOl in HOL

- "we assume that an uninterpreted constant symbol ⋆ of type i *be* in the signature": is?
- Definition 12: Do not use a ^ over a full term. For s ^= t, do you mean ^(s = t) or s ^(=) t? Use \widehat instead or some symbols that scales. Don't rely on the ability of the reader to guess based on the height in line and the centering above the symbols.
- proof of lemma 1 "tedious evaluation steps"

1.4 Exploring Axioms Systems for Category Theory

1.4.1 Modelling of basic concepts

- Fig 2:
  • take the screenshot, once the slow metis call you have has finished
  • I find the cartouches (i.e., ‹› or \<open> \<close>) less disturbing that {* * } and \<comment> is less disturbing than –. So intead of "–{* comment *}", the screenshot would contain "— ‹comment›"

- Fig 3: remove the LaTeX commands in the Isabelle screenshot ("\makebox[2cm][l]"). Don't scare readers.

1.5 Bibliography

- Entries have a different style:
  • Some have a DOI, some don't.
  • Missing editors in, e.g., 17 and 30
  • Some journals names are abbreviated (J of Formalized Reasoning), most are not.
  • "Add a tour of CVC4: how it works" ~> "How it works" with capital H
  • "More SPASS with Isabelle - Superposition with Hard Sorts and Configurable Simplification": use " – " instead of " - "

2 Isabelle Formalisation

- You are abusing contexts. Locales are made from your purpose. Use "sublocale AxiomSet1 ⊆ AxiomSet2" to show inclusion.
- You mention issues with z3, SPASS, and Sledgehammer. Have you reported them?
- In many cases, you are using @{text } where @{term } would probably be better.

3 arXiv paper "Axiomatizing Category Theory in Free Logic"

- Bibliography: "Makarius Wenzel. The *isabelle* system manual.": Isabelle
- footnote "This minimal set of axioms is also mentioned by Freyd in [?] and attributed to Martin Knopman": fix reference

----------------------- REVIEW 2 ---------------------
PAPER: 8
TITLE: Automating Free Logic in HOL, with an Experimental Application in Category Theory
AUTHORS: Christoph Benzmüller and Dana Scott

Overall evaluation: 2 (accept)

----------- Overall evaluation -----------

The paper presents a shallow embedding of a free logic. Free logic is a way to reason about (non-)existence of individuals that are denoted by variables. The presented logic is used to axiomatise category theory. In category theory, the main operator (composition) is partial, and this can be dealt with in different ways. The authors seem to favor a strict operator (where the existence of the result of the operator implies the existence of the arguments).

The paper claims to be based on the contributions of two previous papers: one on the embedding of free logic, and the other on its use for category theory. The paper does not claim any novel results. This is unfortunate, as the combination of the two topics raises a question that is not addressed in the paper: the * (standing for some undefined object) is not required in the exploration of category theory. Lack of this object, and the choice function that uses it, greatly simplifies the free logic and the corresponding embedding. What is this simpler version, and does the observation that * is not really needed justify making this simplification? Without such analysis, I do not see any added value of putting together two somewhat unrelated papers.

I recognise the lack of novel material may be a disqualifier for the paper, and the above may be considered as suggestions towards adding the required novel material. The authors have made the lack of novel material so clear in their paper, that I can only write this review and the corresponding marks in full expectation that no new material is required.

In that light, I do think the research is interesting. The availability of the Isabelle files has made the research highly reproducible. The paper is well written, and I recommend the acceptance of this paper.

There are some observations I would like to make about the paper. They are to be regarded as a high-level commentary that I hope will help the authors further improve the paper. They are not qualifying or disqualifying, or things that necessarily have to be addressed - those comments follow at the end of this review.

The shallow embedding of FFOL is trivial: this is because FFOL is defined through its models. The 'shallow embedding' is nothing more than simply repeating the definition of FFOL (Definition 12 and 3 respectively). This makes Theorem 1 trivial, but does not make the work trivial. The introduction of a variation on the forall quantifier and the selection operation are both interesting. However, when calling FFOL a 'Logic', I would expect to see (preferably sound and complete) calculi. The references [6,7] on page 7 do not mention FFOL.

Using the shallow embedding, there were some observations I could make about FFOL using Isabelle: - Formula's are not implicitly universally quantified. - Under the reasonable assumption that "I id" is undefined, there either Exist x and y that are unequal, or y \neq y for all (existing) y. - "I phi" is either equal to *, or it exists. - If alpha is such that: forall y. alpha \neq y, and alpha is unequal to *, then alpha is unequal to "I phi" (regardless of phi). Note that the last two statements fall outside of the syntax of FFOL, but could be restricted to letting phi be any formula of FFOL. It would be interesting to see what a free higher order logic would look like, and if it could be embedded in a similar way: could we, for instance, obtain a logic in which formulas and terms with free variables exist only if their evaluation does not distinguish between non-existing values (i.e. phi[x:=c_1] = phi[x:=c_2] if both c_1 and c_2 don't exist, otherwise phi does not exist). The experiments mentioned above, as well as the question, affirm my belief that the chosen shallow embedding is fun to play with, and that other readers might find it interesting as well.

The other theme in the paper is that of axiomatization of category theory.

The strictness laws of category theory are disputable: developing category theory in a non-strict setting is appealing as it allows for more structures to be categories. A strict version of such a non-strict operator could be derived: if either argument does not exist, return the first non-existing argument. Is the strict version of a category satisfying axioms set FS-III indeed equivalent to axiom set VI? Axiom set FS-IV suggests this!

It is worth noting that the Kleene equality (KlEq) and the non-reflexive existing identity (ExId) can both be defined within FFOL. In fact, this is done in the Isabelle files provided by the authors. It could also be noted that KlEq and ExId can be defined in terms of one another without use of primitive equality, but that this primitive equality cannot be recovered. Again, this is a missed opportunity on doing something novel except putting two previously published articles together.

In category theory, limits and co-limits are partial operations as well. It would be interesting to see a similar analysis in FFOL.

A few more detailed remarks:

- A1 in Axiom Set FS-I: the arrow needs to point both ways (FS write 'iff'). This has to be fixed. - The numbering of the axiom sets with and without FS is confusing. I would like to see FS-I, FS-II .. renamed to FS-A, FS-B or to FS-VII, FS-VIII, ...