JavaScript à la Carte

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CCS Concepts: • **Software and its engineering → Software verification**.

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1 Introduction

Half a page for overview and explaining motivation

2 à-la-carte-ness

Why Rocq[9], coq a la carte as a foundation, why can't use directly, imporovements, what I want to do

Main citation: Coq à la Carte[5]

3 Targets for formalization

There is yet to be a significant test of modularity for mainstream programming languages formalization.

We propose a case study that would evaluate existing approaches for modular Rocq developments. The aim of the study is to find and address, when possible, their shortcomings, improve tooling and enable them to support practical proofs. We choose JavaScript as a target language for mechanisation.

There are several[6][1] developments that attempt to formalize and reason about JavaScript, however non of them is easy to extend for with new features. Being one of the most used language, JavaScript provides a fertile ground for evaluating existing approaches for modular reasoning. Lack of sophisticated type system streamlines the encoding and makes it possible to gradually prove language properties, while keeping the formalization open to extension. Extensive specification[3] in natural language is also a very welcome addition.

To the best of our knowledge no modular technique from above was ever used for mechanisation of a mainstream language.

The following theorems seem to be good candidates for the study:

- preservation of local closeness w.r.t small step semantics

```
forall c e c' e', lc e
                -> step c e c' e'
                -> lc e'.
```

- progress theorem

```
forall c e, lc e
          -> isValue e
          \/ isError e
          \/ (exists c' e', step c e c' e').
```

Find citation for dialects and t39 proposal

Moreover, JavaScript has several frameworks[4] and dialects[] that enable different styles of programming. Ability to reuse proofs about core language for dialects would be a nice showcase of modularity. The t39 proposal process[] is transparent and permits mechanization of ongoing specification of nightly features before they are adopted to core language.

4 Discussion

There are other solutions to increase modularity of proofs.

Proof modularity papaers

1. Family Polymorphism[7]
   Rocq plugin for type family polymorphism
2. Program Logics à la Carte[11]
   Coinduction with ITrees.
3. Interpreters à la Carte[10]
   Containers as functors for fixpoints

Argue about that indirect encoding is too taxing.

It's interesting to look into the possibility of gradually encoding calculus of inductive constructions in a modular fashion.

Proof modularity comes with the cost of departing from the usual way of reasoning about inductive types. Even in case of Coq à la Carte departure is not quite dramatic, but still requires to rethink how one approaches proofs.

The ideal solution would be to have a correspondence between modular and inductive proofs. There is an existing work[8][2] that could enable that proofs transfer between "equivalent" datatypes.

Talk about how they achieve that and is it possible to leverage that for functor representation of chosen datatype.

Is it possible to use containers as a meta language, while presreving ability to do actual reasoning with inductive types in Rocq?

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