On Julia’s Efficient Algorithm for Subtyping Union Types and Covariant Tuples (Artifact)

Benjamin Chung
Northeastern University, Boston, MA, USA
bchung@ccs.neu.edu

Francesco Zappa Nardelli
Inria, France
francesco.zappa_nardelli@inria.fr

Jan Vitek
Northeastern University, Boston, MA, USA
Czech Technical University in Prague, Czech Republic
j.vitek@neu.edu

Abstract
The key claim in our paper Julia’s efficient algorithm for subtyping unions and covariant tuples is that our algorithm works. This artifact provides support for that claim through two means: a Coq proof of the algorithm’s correctness and an implementation of the algorithm. The single-file proof contains three proof-generating implementations of subtyping, based on normalization and two variations on the subtyping algorithm we describe. The implementation consists of a web interface to an OCaml implementation of our algorithm, which checks subtyping between any two arbitrary user-defined types and generates both the answer and a trace of algorithm execution.

2012 ACM Subject Classification Theory of computation → Type theory; Software and its engineering → General programming languages
Keywords and phrases Type systems, subtyping, algorithmic type systems, distributive unions
Digital Object Identifier 10.4230/DARTS.5.2.8

1 Introduction
This is the artifact for the pearl paper “On Julia’s efficient algorithm for subtyping union types and covariant tuples.” It consists of two primary components:

- index.html: An implementation of the subtyping algorithm running in a webpage. This implementation is modified only slightly from the one described in the paper to enable visualization. For sources, see the web-impl directory.
- julia-iterators.v: The Coq source code for the proofs referenced in our paper.

This document is a worse-formatted and non-executable version of index.html. We suggest the the online version (at https://benchung.github.io/subtype-artifact/) or simply open index.html from the artifact archive for information on the artifact and to try out our algorithm. The website version of the artifact is tested to work in Google Chrome, and should work in all modern browsers.
2 Proof

The proof script (found in proof/julia-iterators.v) depends on Coq 8.9.0. A detailed description of our proof can be found in section 3 of the paper. The proof is standalone, and has no library dependencies.

It relies on the standard library provided axiom Eqdep.Eq_rect_eq.eq_rect_eq, which establishes the invariance under substitution of dependent equality. In our formalization, structural type iterators are dependent upon the type over which they iterate. We rely on this axiom to decide when two iterators are iterating over the same or different types. It is an axiom in our system as it is independent of the calculus of constructions.

3 Implementation

We include a web implementation of our algorithm. To use it, please see index.html for the running implementation and instructions on its use and compilation.

Compiling the Implementation

The implementation is written in OCaml and compiled using js_of_ocaml. It requires:
- OCaml 4.07.0 or later
- opam 2.0.4 or later

To compile the OCaml to Javascript, run

make deps
make

in the web-impl subdirectory, which should update the file web-impl/js/subtype.js.

4 License

Copyright 2019 Benjamin Chung, Francesco Zappa Nardelli, Jan Vitek

The artifact associated with this description is licensed under the Apache License, Version 2.0 (the “License”); you may not use the associated artifact except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an “AS IS” BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License.

5 MD5 sum of the artifact

4d0356d94ed8d21f42e6b73de886f871

6 Size of the artifact

746657 bytes