

Towards Human-Centered Types & Type Debugging

Kasra Ferdowsi
(He/They)
PhD Student

hci.social/@kasra

@kasra_ferdowsi

Overview

A Critique of Foundations for Human-Centered Types*:

1. Expressiveness v. Usability
2. Tool- v. Human-Centric Types

A Concrete Example:

1. A Problem with Rust
2. A Solution?

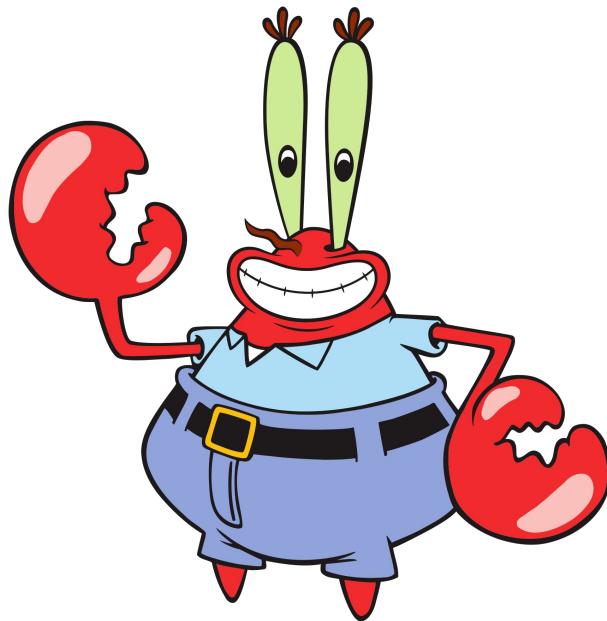
* Technically, any static semantics.



Types are mainstream!



PYRIGHT



Expressiveness v. Usability

Consider Ownership Types*:

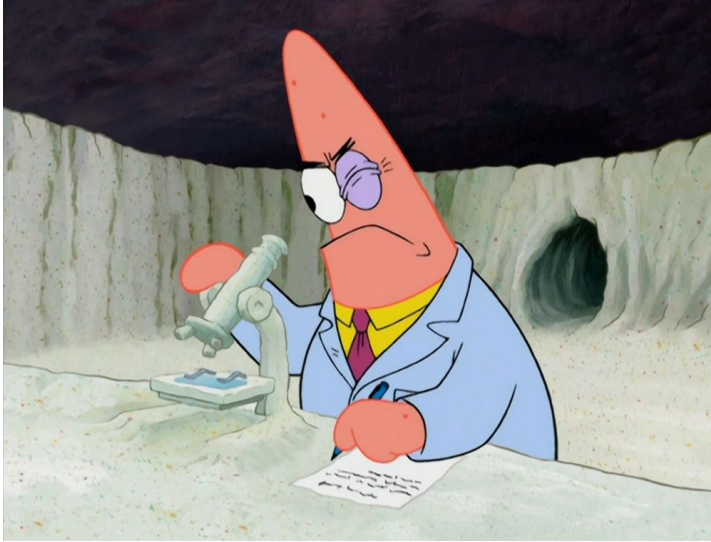
- From Object-Oriented Programming, often for Java.
- Evaluated on...
 - Expressiveness
 - Syntactic Overhead



* [Clarke et al. 1998, Aldrich et al. 2002, Boyapati et al. 2003]

Expressiveness v. Usability*

Expressiveness:



* [Hage 2020]

Usability:



Usability in Type Error Messages^{*}

We've addressed Usability in Type Error Messages:

Experience [...] shows that from a type error message it is often hard to deduce the actual cause of the error and understand it [1, 2, 3, 4, 9, 10, 17, 19, 20, 21, 22, 23, 24, 25, 26].

[Chitil 2001]

But they only focus on error *localization* and *correction*...

And only with *Tool-Centric* solutions.

^{*} [Clack and Myers 1995, Lerner et al. 2007, Chen and Erwig 2014, Zhang and Myers 2014, Tirronen et al. 2015, Zhang et al. 2017]

Tool- v. Human-Centric Debugging

Consider Guided Type Debugging*.

- Elicit feedback from the user:

What is the expected type of `rR`?

- Employ the *User* to help the *tool* understand.

* [Chen and Erwig 2014]

Tool- v. Human-Centric Debugging

Tool-Centric:



Human
~~Squid~~-Centric:



Overview

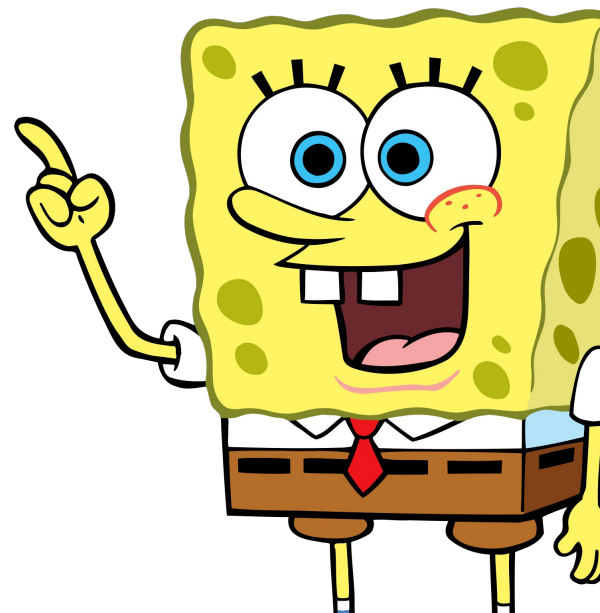
A Critique of Foundations for Human-Centered Types¹:

1. Expressiveness v. Usability
2. Tool- v. Human-Centric Types

A Concrete Example:

1. A Problem with Rust
2. A Solution?

¹ Technically, any static semantics.



A Problem with Rust

Rust's Ownership:

- At most *single mutable* access to each value in the program.
- Statically guaranteed by its type system.

Rust's usability:

"Learning Rust Ownership is like navigating a maze where the walls are made of asbestos and frustration, and the maze has no exit, and every time you hit a dead end you get an aneurysm and die"

Student Participant from [Coblenz et al. 2022]

A Problem with Rust

Error *localization* and *correction*

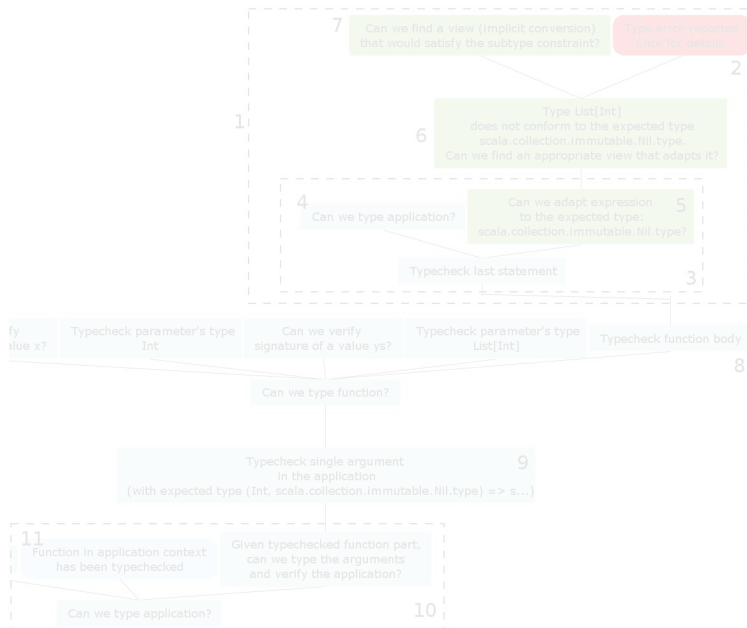


Feedback that "aid design and comprehension"



A Solution?

Scalad [Plociniczak 2016]



Compositional Exploration of Types
[Chitil 2001]

Expression: `(:)` (last xs)
Type : `[a]→[a]`
with xs `[[a]]`
because
Expressions: `(:)` last xs
Types: `a→[a]→[a]` b
with xs `[[b]]`

A Solution?

$x : b$



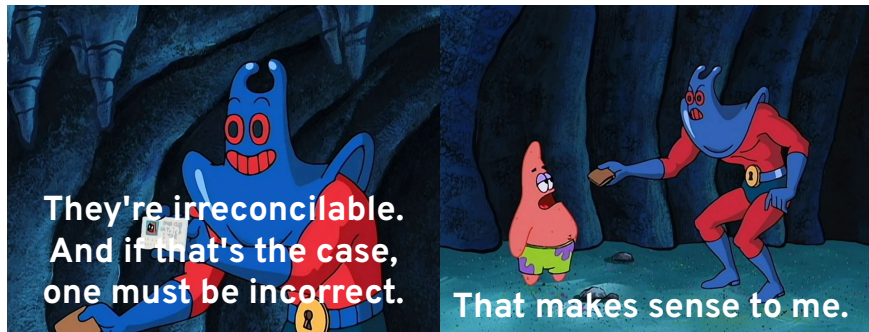
$x : [[b]]$



Expression: $(:)$ (last xs)
Type : $[a] \rightarrow [a]$
with xs $[[a]]$



Human-Centered Type Debugging

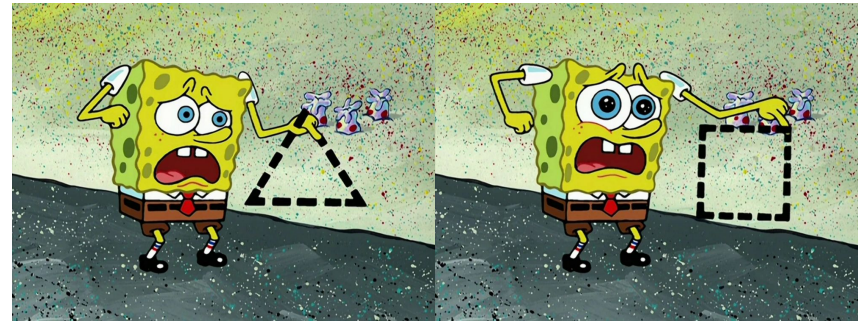


A Solution?

Larger architectural implications?



Summary



Also Happy Valentine's Day!!!



Feedback / Questions / Favorite Love Song?

