

Evolving the OCaml programming language

KC Sivaramakrishnan
kcsrk.info

IITM CSE Bytes
4th November 2025

IIT
MADRAS



Tarides

Who am I — KC Sivaramakrishnan

- CS Prof at IIT Madras
 - Programming languages, formal verification and systems
- A core maintainer of the *OCaml* programming language
- CTO at Tarides
 - Building functional systems using *OCaml*
 - Maintainers of the OCaml compiler and platform tools

File Edit Search Run Compile Debug Project Options Window Help

[■] **NONAME00.CPP** **1=[↑]**

1:1

F1 Help F2 Save F3 Open Alt-F9 Compile F9 Make F10 Menu

- Turbo C++ IDE
- Learnt to program C here

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- Grew up and realised neither was!
- This talk is about the evolution of programming languages
 - Specifically, OCaml





Language

- Functional-first but multi-paradigm (imperative, OO)
- Static-type system with Hindley-Milner type inference
- Advanced features — powerful module system, GADTs, Polymorphic variants
- Multicore support and *effect handlers*



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- Fast, native code— x86, ARM, RISC-V, etc.
- JavaScript and WebAssembly (using *WasmGC*) compilation
- **Platform tools** — editor (LSP), build system (dune), package manager (opam), docs generator (odoc), etc.



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Ecosystem

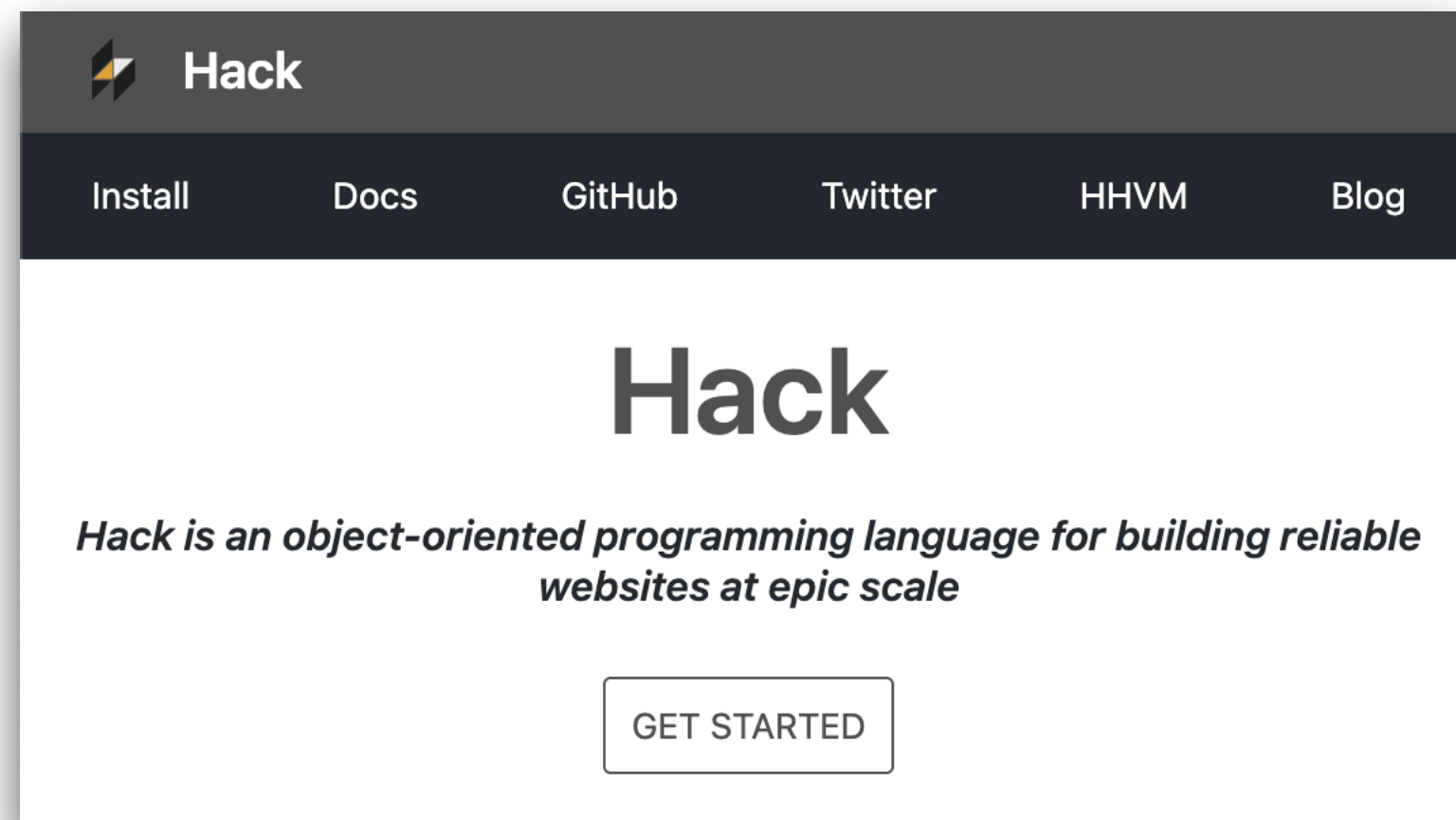
- Opam repository — small but mature package ecosystem
- Notable Industrial users — Jane Street, Meta, Microsoft, Ahrefs, Citrix, Tezos, Bloomberg, Docker

High dynamic range

*From scripts to scalable systems, research
prototypes to production infrastructure*

High dynamic range

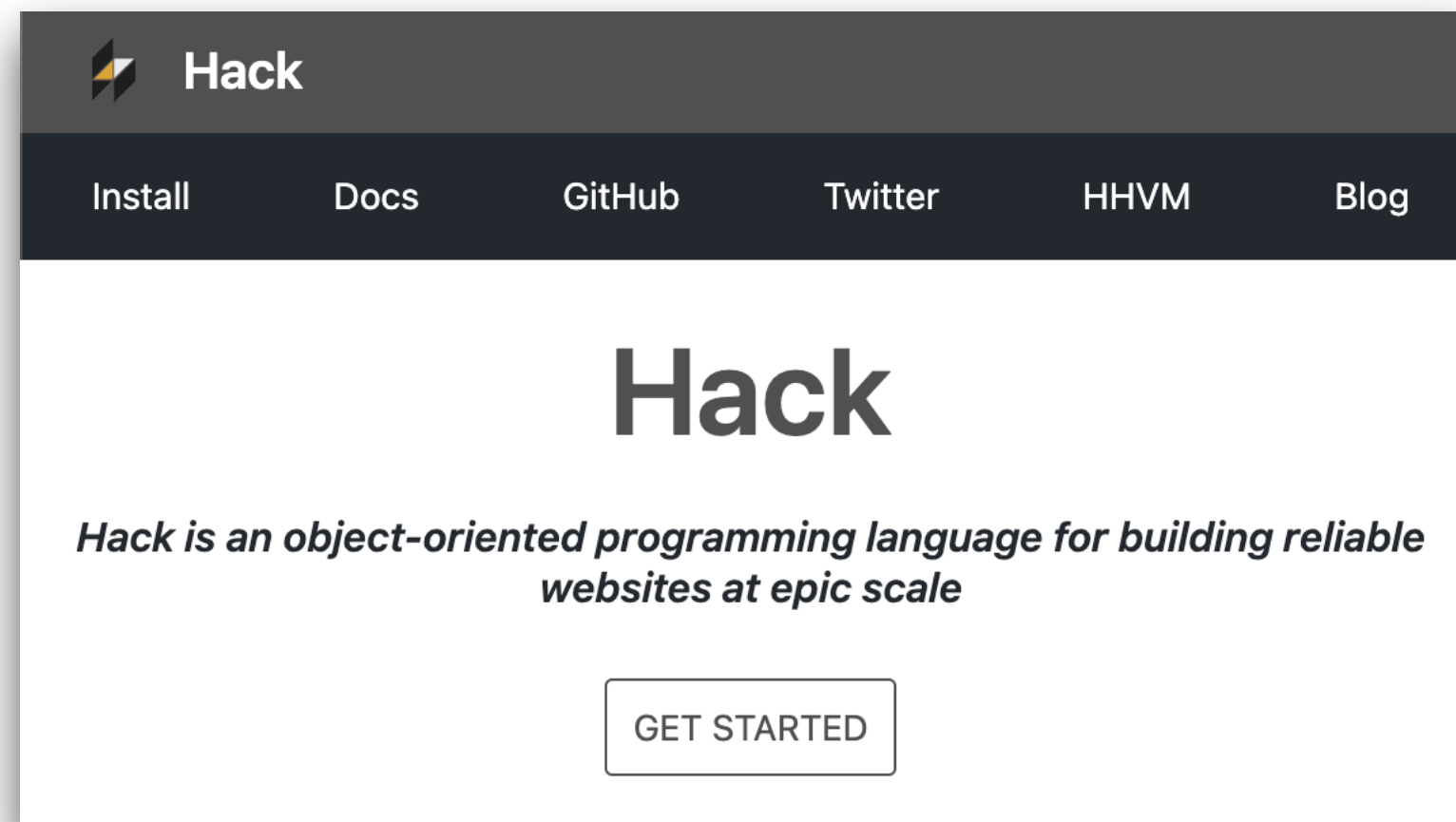
From scripts to scalable systems, research prototypes to production infrastructure



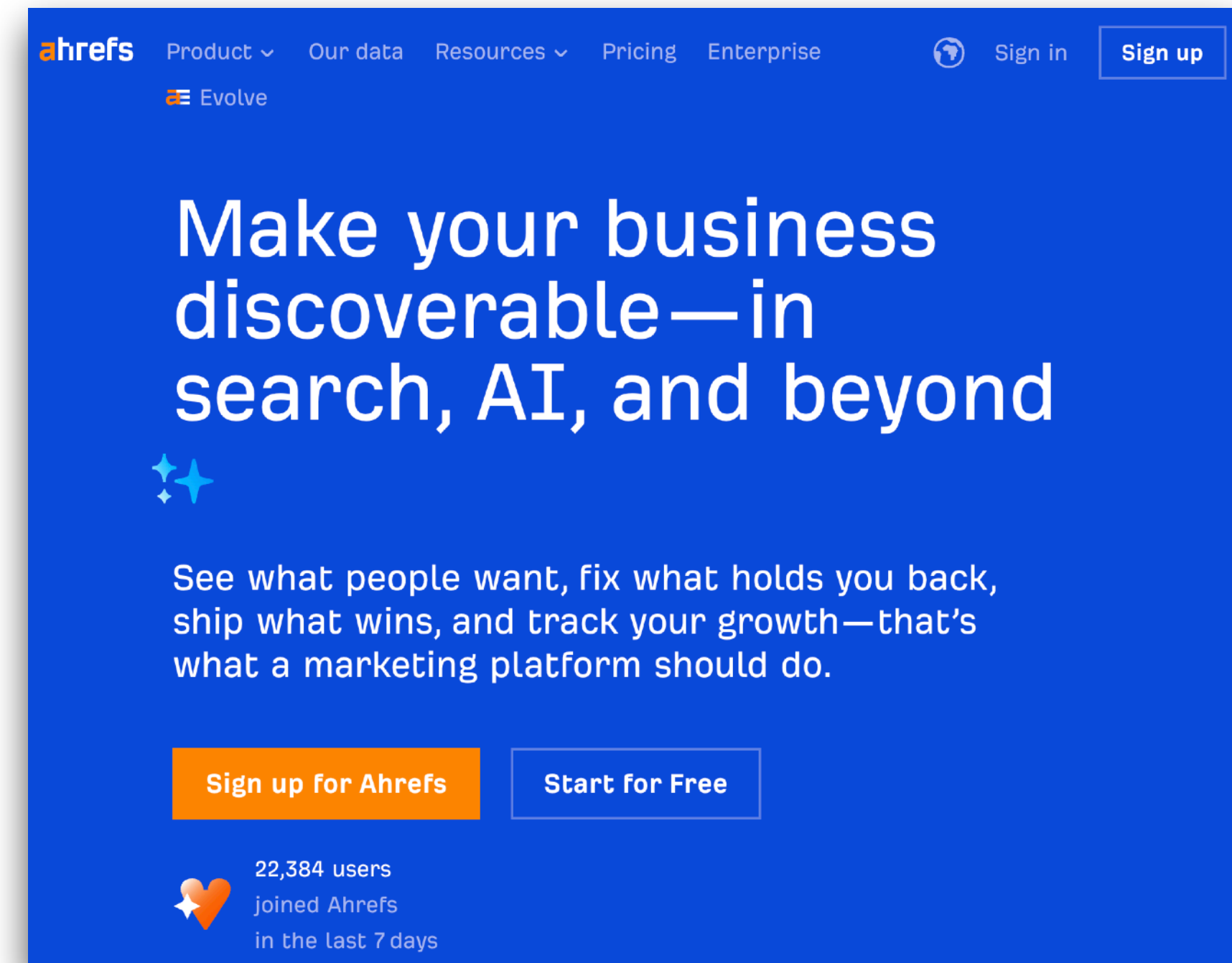
Compilers

High dynamic range

From scripts to scalable systems, research prototypes to production infrastructure



Compilers



Web Frontend

High dynamic range

From scripts to scalable systems, research prototypes to production infrastructure

Functional Networking for Millions of Docker Desktops (Experience Report)

ANIL MADHAVAPEDDY, University of Cambridge, United Kingdom

DAVID J. SCOTT, Docker, Inc., United Kingdom

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RYAN T. GIBB, University of Cambridge, United Kingdom

THOMAS GAZAGNAIRE, Tarides, France



Docker is a developer tool used by millions of developers to build, share and run software stacks. The Docker Desktop clients for Mac and Windows have long used a novel combination of virtualisation and OCaml unikernels to **seamlessly run Linux containers on these non-Linux hosts**. We reflect on a decade of shipping this functional OCaml code into production across hundreds of millions of developer desktops, and discuss the lessons learnt from our experiences in integrating OCaml deeply into the container architecture that now drives much of the global cloud. We conclude by observing just how good a fit for systems programming that the unikernel approach has been, particularly when combined with the OCaml module and type system.

CCS Concepts: • **Software and its engineering** → *Software system structures*; **Functional languages**; • **Computer systems organization** → **Cloud computing**.

Virtualisation and Networking

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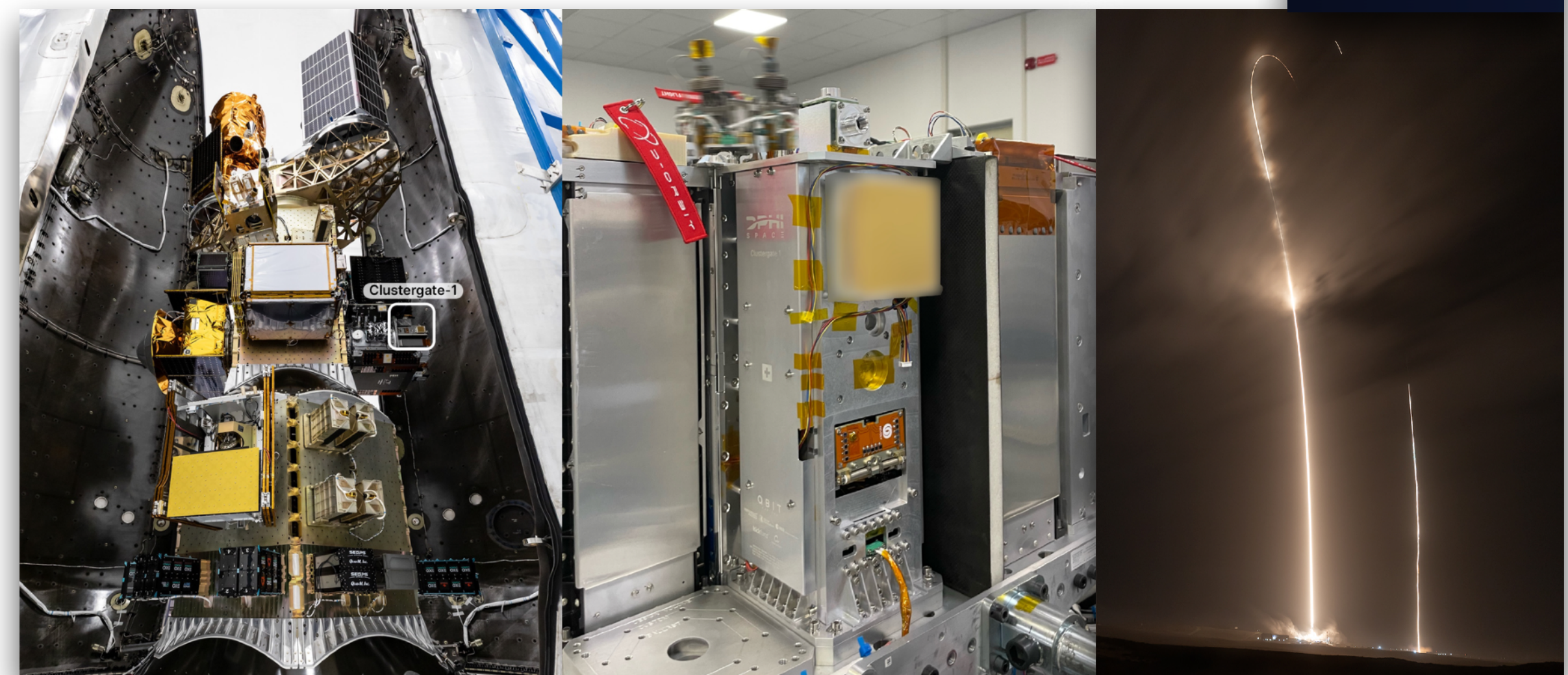


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OCaml in Space 🚀

 Parsimoni



Virtualisation and Networking

High dynamic range

*From scripts to scalable systems, research
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*60+M lines of
OCaml code!*

Bloomberg

Finance

High dynamic range

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Finance

60+M lines of OCaml code!

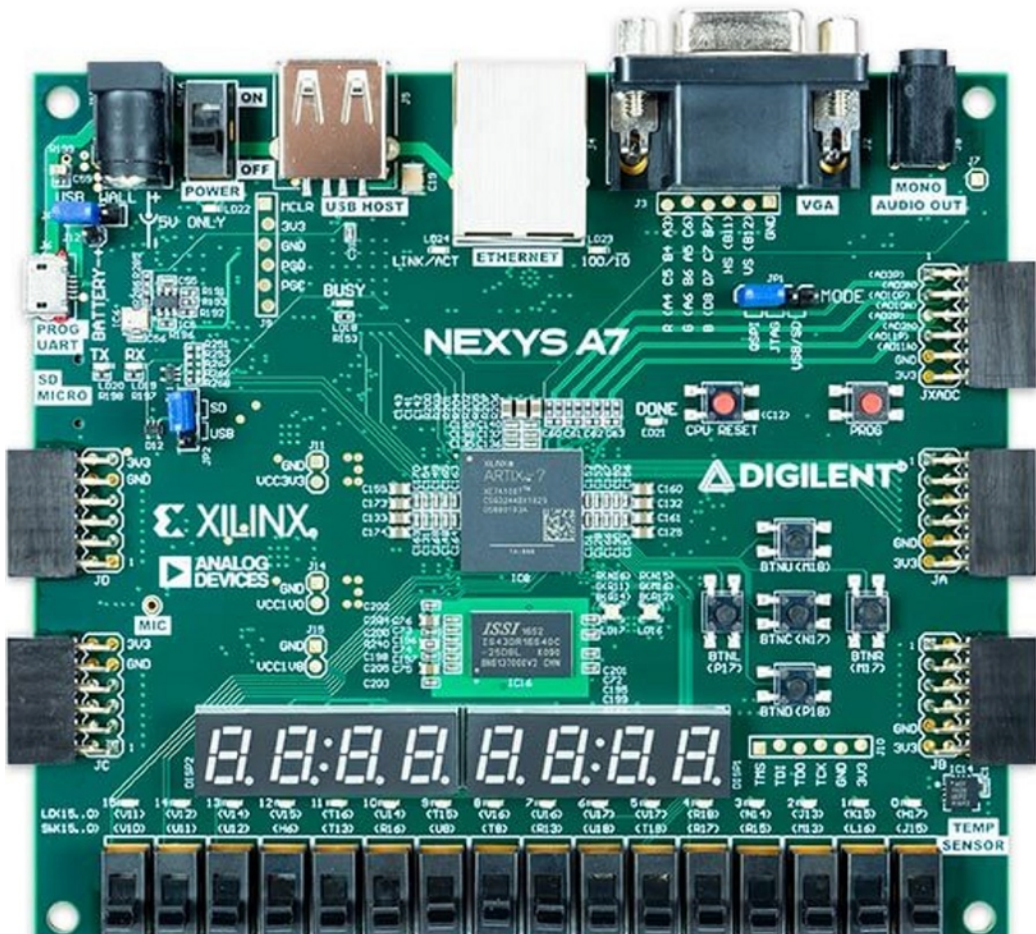
A poster for the Hardcaml ZPrize competition. It features a stylized circuit board design with a central chip icon. The text "HARDCAML" is prominently displayed. Below it, a paragraph describes the team's participation in the 2022 ZPrize competition, mentioning their wins in the Multi-Scalar Multiplication (MSM) and Number Theoretic Transform (NTT) tracks. At the bottom, it says "Read on to find out more about our submissions and view the code on github." The ZPRIZE logo is at the bottom left.

HARDCAML

In 2022, we, the team who develops Hardcaml (Andy Ray, Ben Devlin, Fu Yong Quah, and Rahul Yesantharao) participated in the ZPrize competition. We competed in the Multi-Scalar Multiplication (MSM) and Number Theoretic Transform (NTT) tracks, winning the MSM FPGA track and coming second in the NTT track.

Read on to find out more about our submissions and view the code on [github](#).

ZPRIZE



Hardware design





29 years old!



29 years old!





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1996 — OCaml 1.0

*Object system, low-latency GC, fast
native backend, module system*

1973 — Robin Milner's “ML” for LCF

Type system, type inference



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Categorical abstract machine (CAM) as IR



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2022 — OCaml 5.0

Multicore parallelism, effect handlers

Steady evolution
over **50+** years

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2025

Steady evolution
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**How to *thrive* not just
survive after ~30 years?**

Simplicity and ***stability***

Simplicity and *stability*

Xavier Leroy, 2023 SIGPLAN programming languages software award! 🏆

What made that possible? Not just fancy types and nice modules – even though systems programmers value type safety and modularity highly – but also basic properties of OCaml:

- a language with a simple cost model, where it's easy to track how much time and how much space is used;
- a compiler that produces efficient code that looks like the source code, with only predictable optimizations;
- a low-latency garbage collector, usable for soft real-time applications.

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- If you take OCaml from 20 years ago, the code will likely *continue to work!*

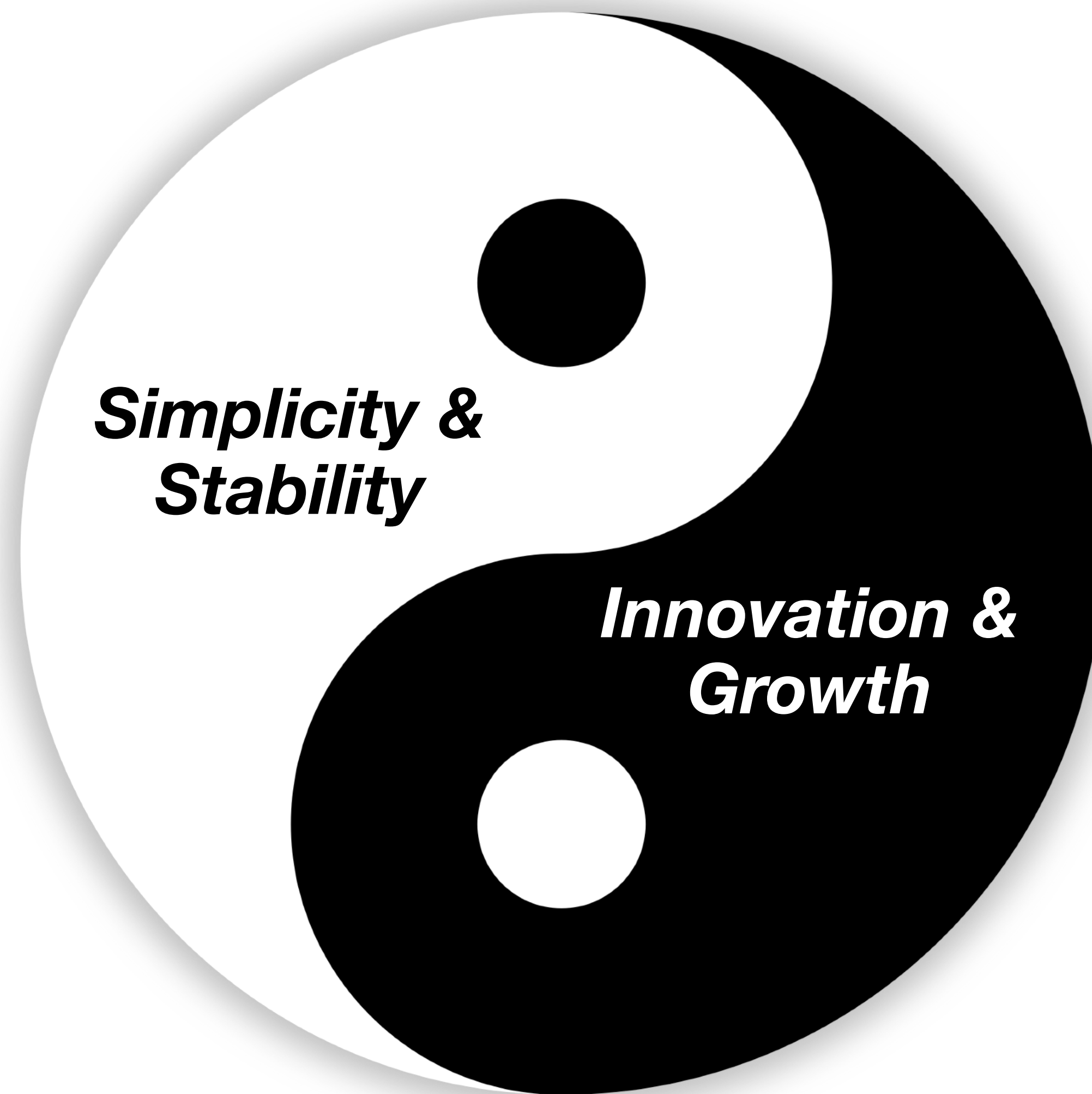
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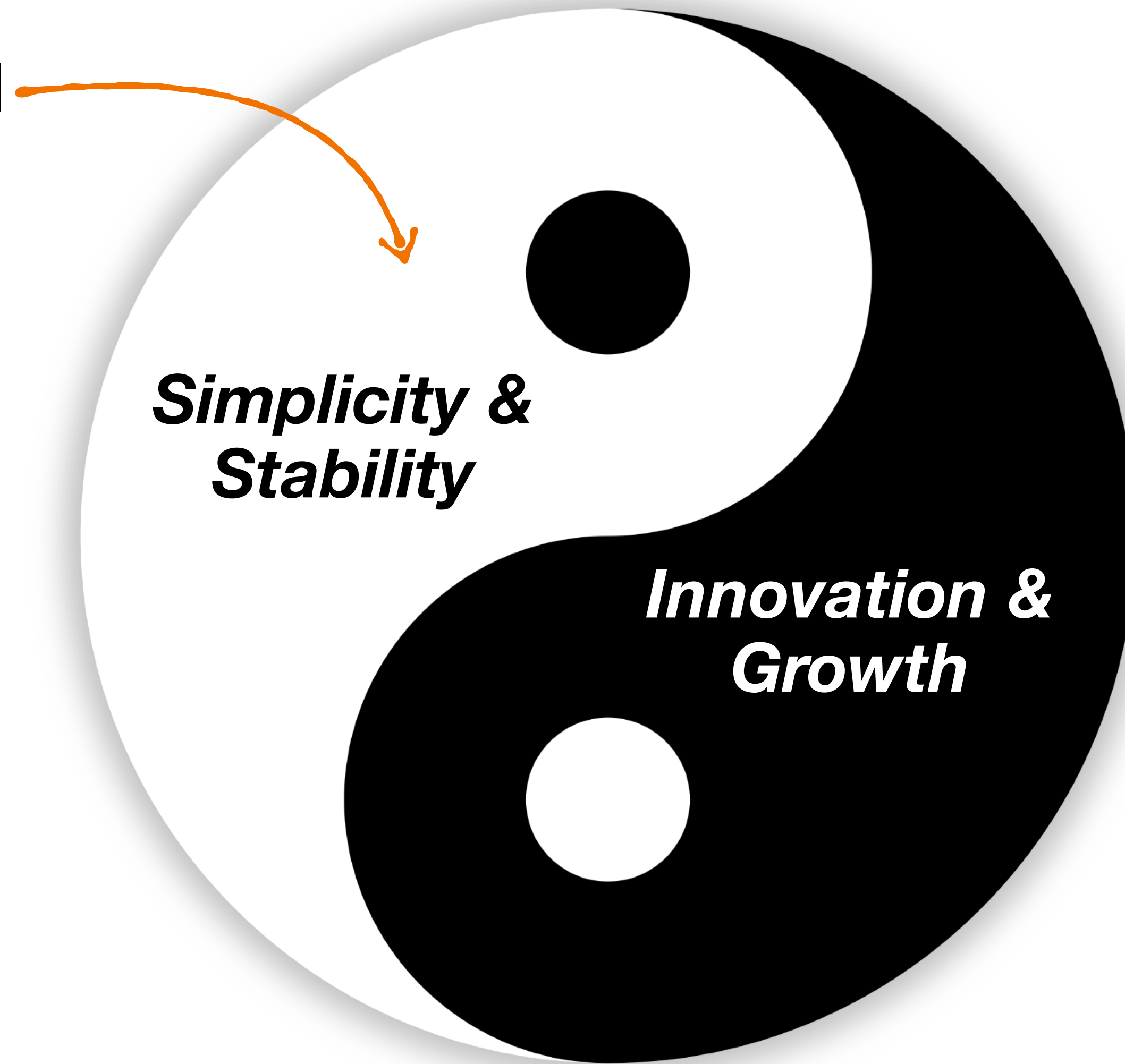
- If you take OCaml from 20 years ago, the code will likely *continue to work!*
- No recent releases for some popular packages
 - They are *good enough*, and continue to be so.
 - Nothing to be done to keep it working!



***Simplicity &
Stability***

***Innovation &
Growth***

OCaml



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OCaml Maintainers

Abigael

Alain Frisch

Armaël Guéneau

Anil Madhavapeddy

Pierre Chambart

Damien Doligez

David Allsopp

Jacques Garrigue

Gabriel Scherer

Richard Eisenberg

Jacques-Henri Jourdan

KC Sivaramakrishnan

Frédéric Bour

Leo White

Vincent Lavyron

Luc Maranget

Mark Shinwell

Nick Barnes

Nicolás Ojeda Bär

Florian Angeletti

Olivier Nicole

Sadiq Jaffer

Sébastien Hinderer

Stephen Dolan

Thomas Refis

Xavier Leroy

Jeremy Yallop

- 27 maintainers from France, UK, Japan, India and USA, across industry and academia.

OCaml Maintainers

| | | |
|-------------------|-----------------------|--------------------|
| Abigael | Richard Eisenberg | Nicolás Ojeda Bär |
| Alain Frisch | Jacques-Henri Jourdan | Florian Angeletti |
| Armaël Guéneau | KC Sivaramakrishnan | Olivier Nicole |
| Anil Madhavapeddy | Frédéric Bour | Sadiq Jaffer |
| Pierre Chambart | Leo White | Sébastien Hinderer |
| Damien Doligez | Vincent Laviron | Stephen Dolan |
| David Allsopp | Luc Maranget | Thomas Refis |
| Jacques Garrigue | Mark Shinwell | Xavier Leroy |
| Gabriel Scherer | Nick Barnes | Jeremy Yallop |

- 27 maintainers from France, UK, Japan, India and USA, across industry and academia.
- Custodians of the compiler
 - *Not the ones deciding how the language should evolve!*

Who decides how OCaml evolves?

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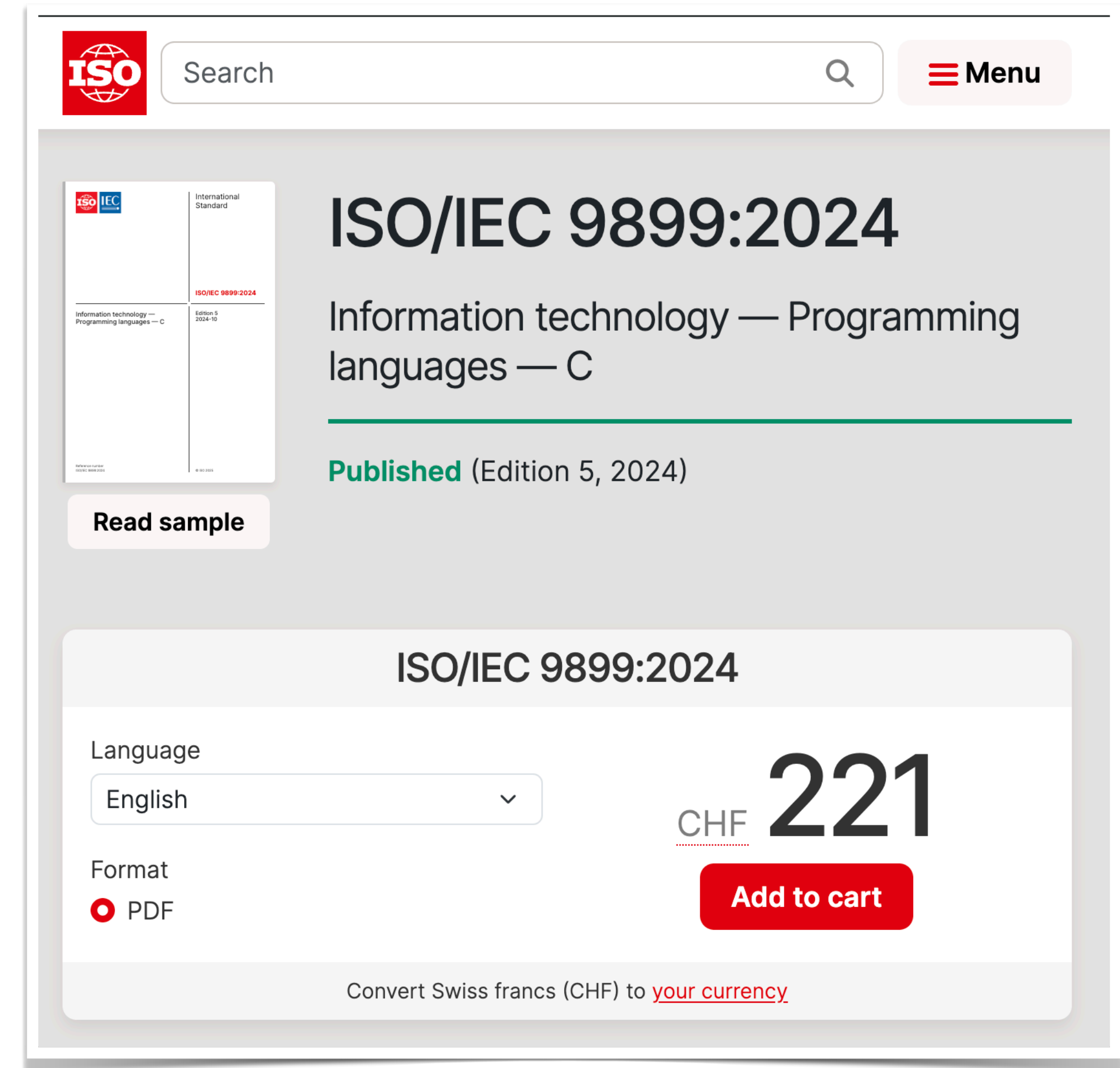
- Evolution
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 - **Vendor-driven consensus:** WebAssembly

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The screenshot shows the ISO/IEC 9899:2024 product page. At the top, there is a search bar and a menu icon. The main content area features a thumbnail of the standard document on the left and the title 'ISO/IEC 9899:2024' on the right. Below the title, it says 'Information technology — Programming languages — C' and 'Published (Edition 5, 2024)'. A 'Read sample' button is located below the thumbnail. At the bottom, there is a section for purchasing the standard, showing the price in CHF as 221 and an 'Add to cart' button. A footer note mentions converting Swiss francs (CHF) to the user's currency.

ISO/IEC 9899:2024

Information technology — Programming languages — C

Published (Edition 5, 2024)

Read sample

ISO/IEC 9899:2024

Language
English

Format
☒ PDF

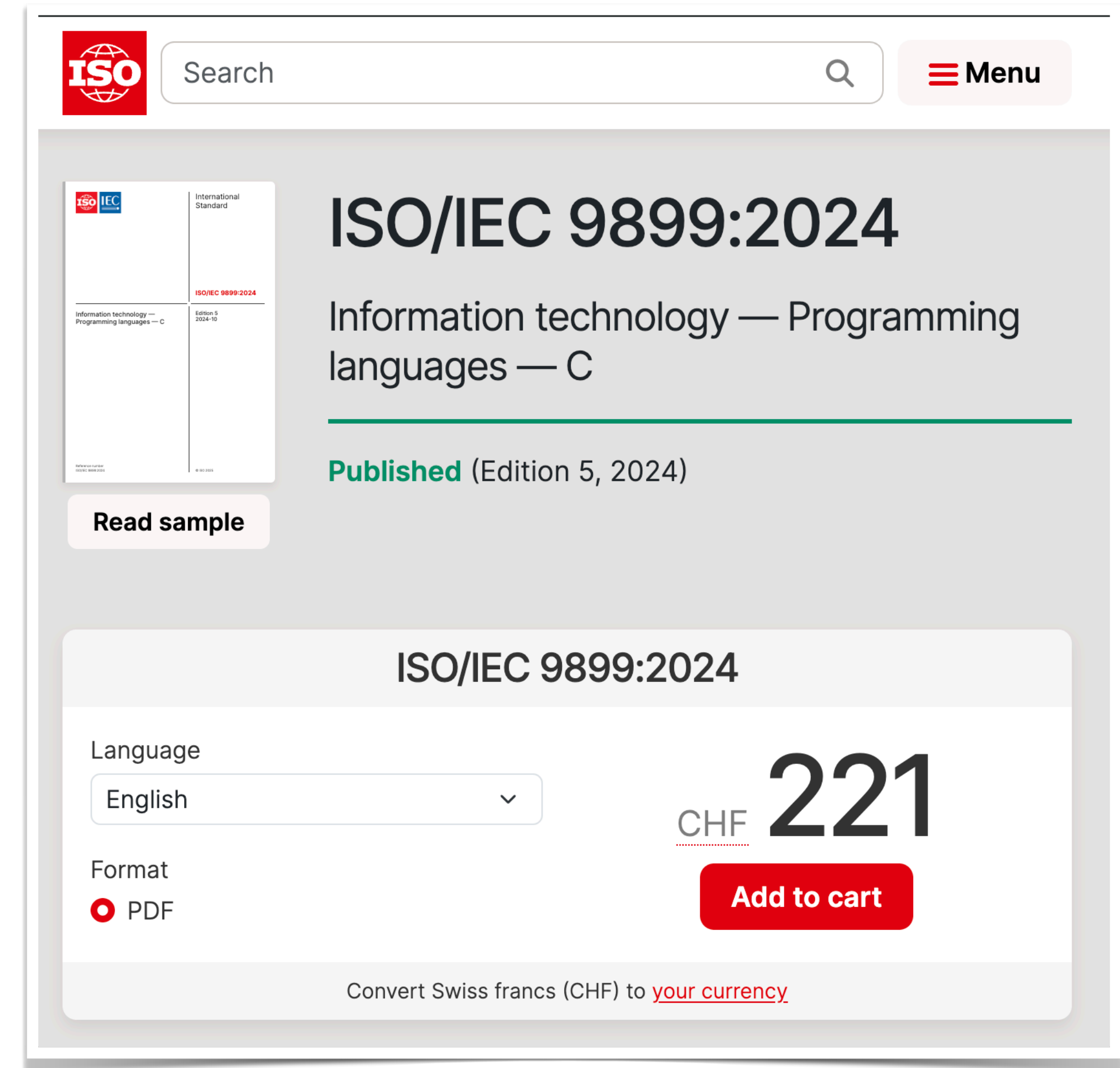
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- *The bar is lower to change the language*



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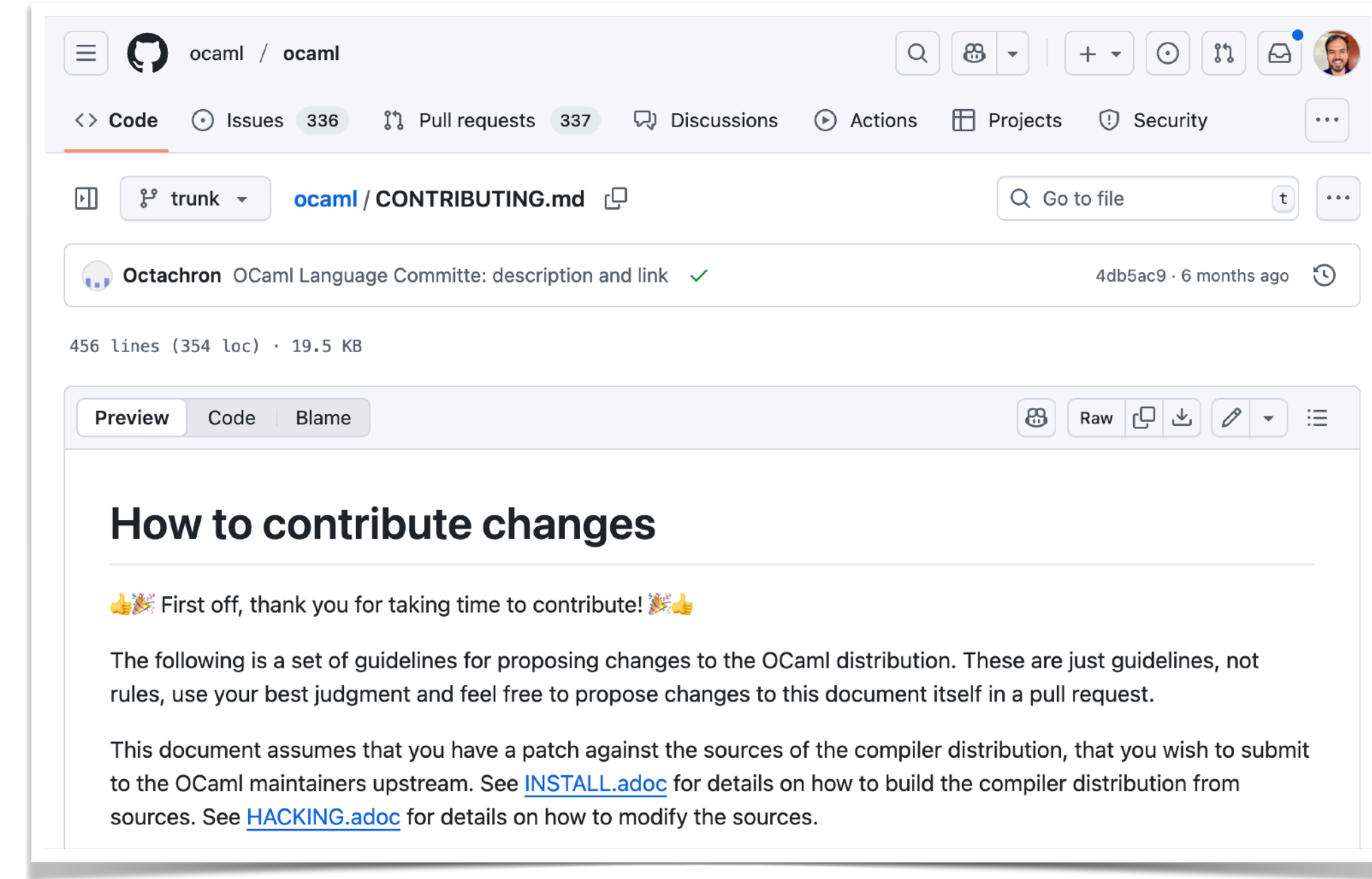
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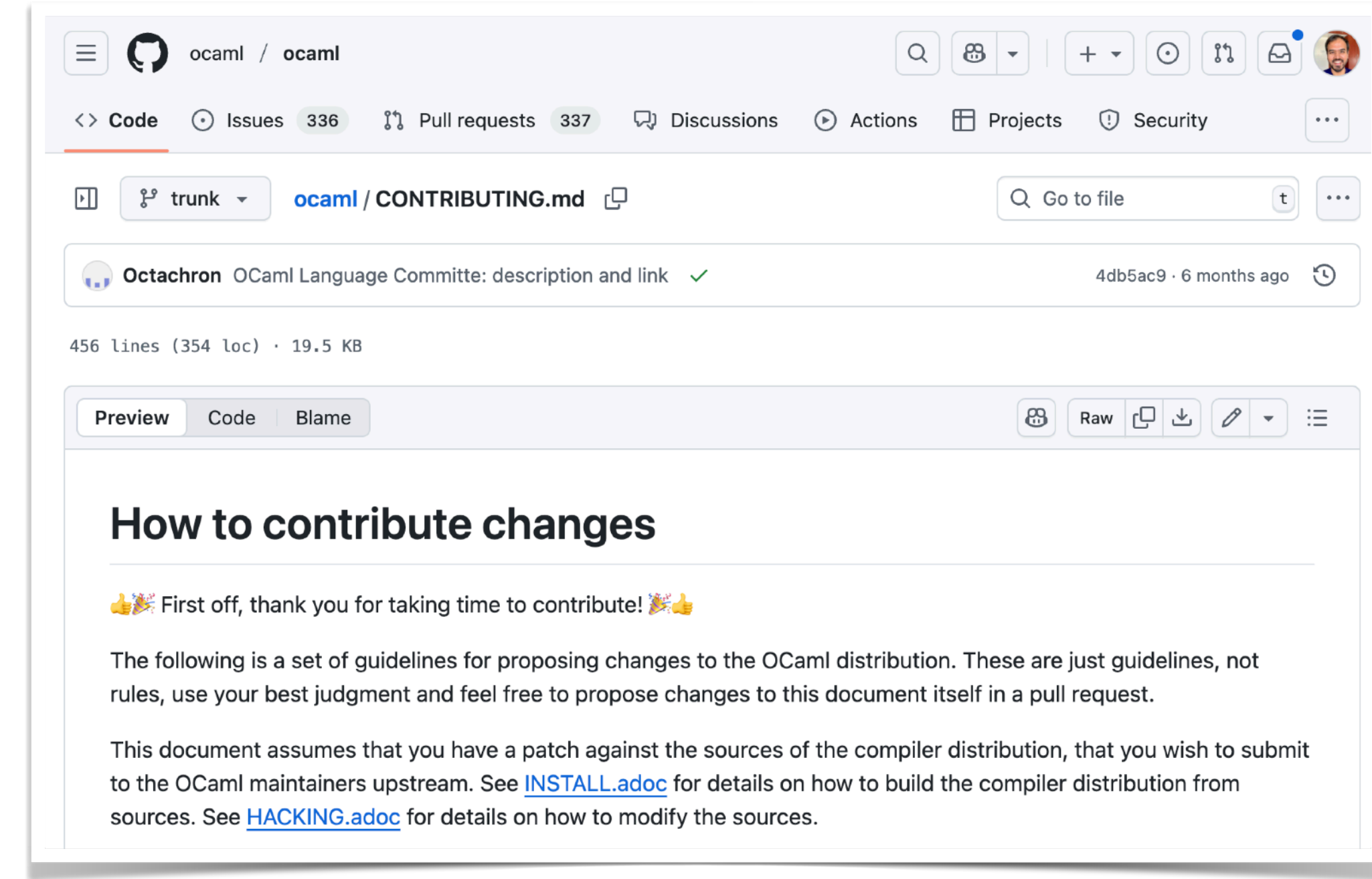
Mechanics of evolution

- Open process
 - OCaml compiler is maintained on GitHub
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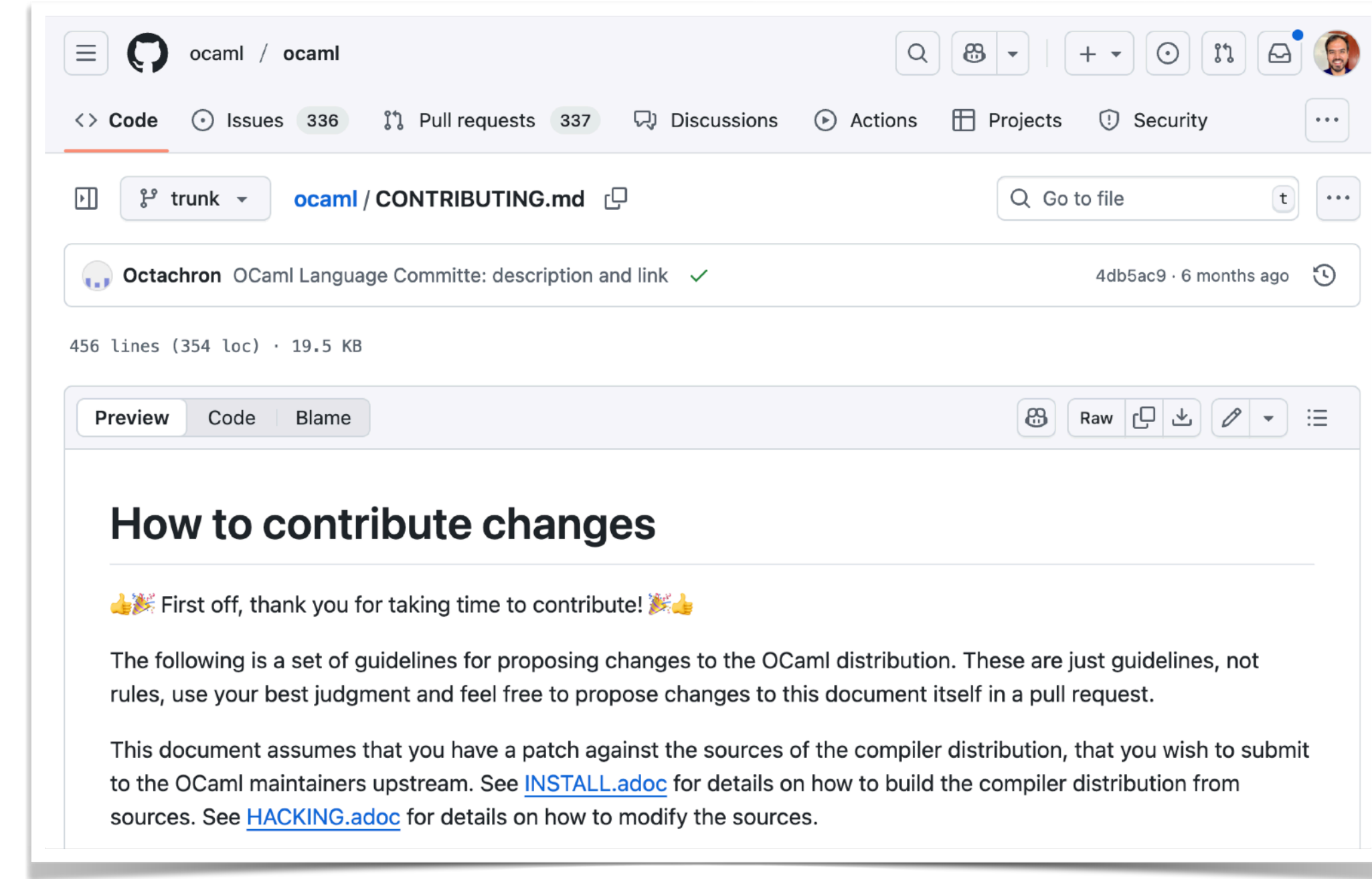
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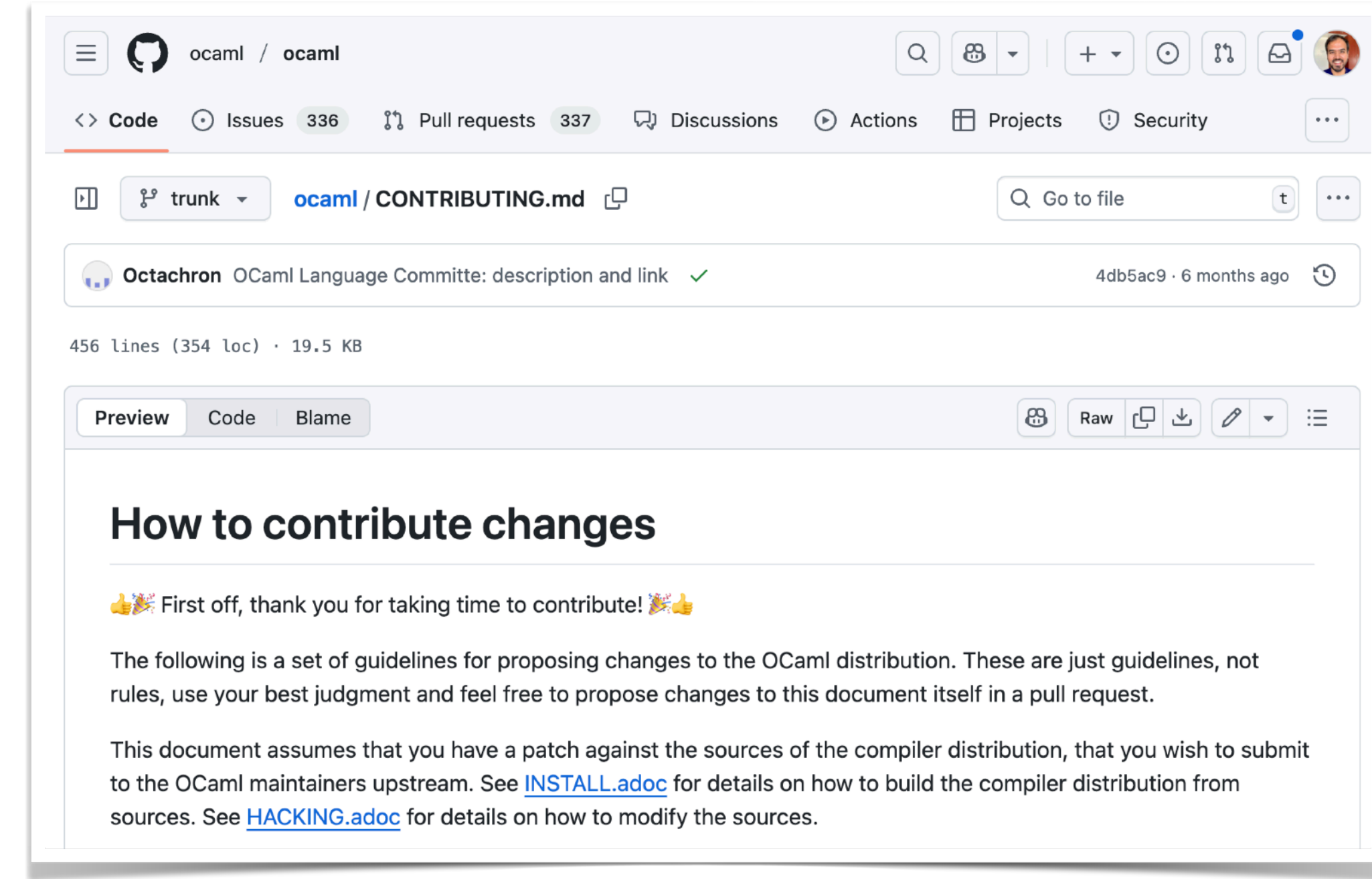
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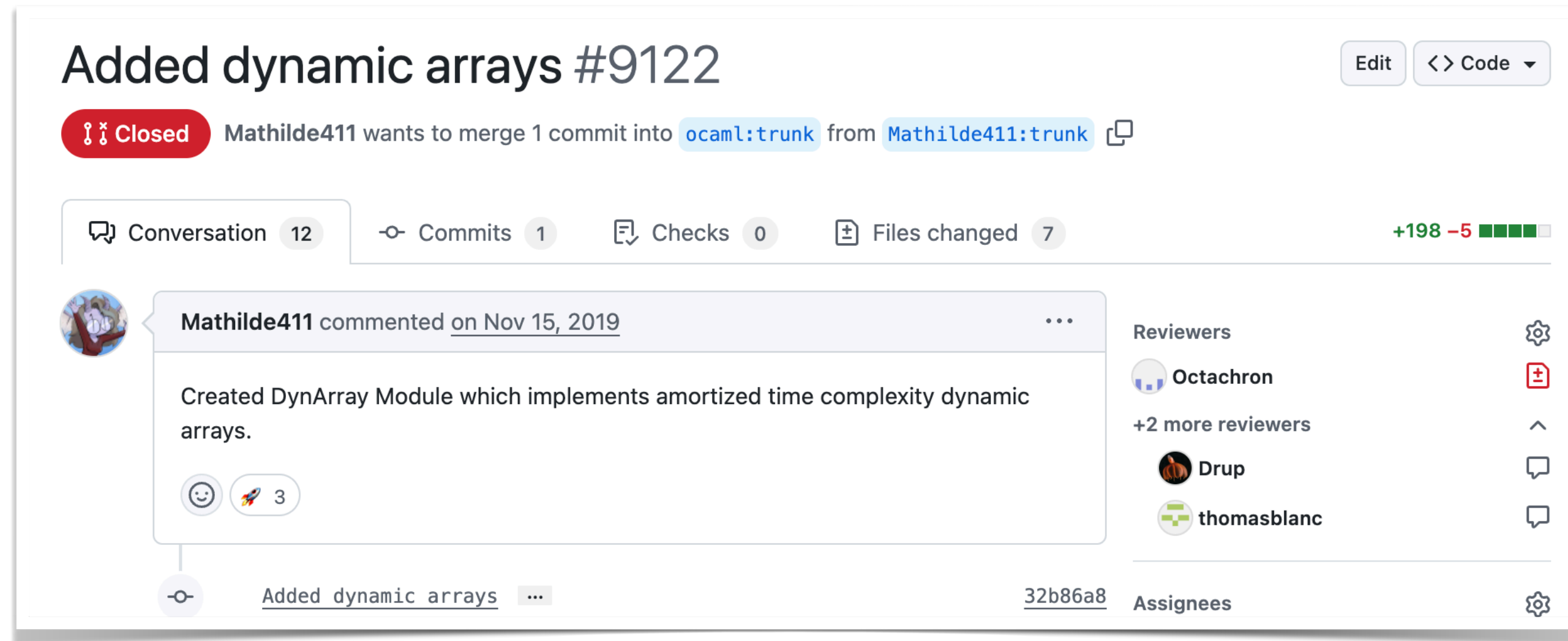


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 - **Small fixes/features** → Make an issue (“feature request”), open a PR, discuss and get that merged
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 - **Large features** → Bespoke based on the features
 - May need publishing papers, extensive performance evaluation, formalised/mechanised soundness results, etc.
- *Often, presumably small feature requests take a life of their own!*



A small(?) change — Dynamic Arrays



Opened: Nov 15, 2019, **Closed:** Nov 15 2019

Implementation rather naive, room for improvements

A small(?) change — Dynamic Arrays

Added dynamic arrays #9122 Mathilde411 wants to merge 1 commit into `ocaml:trunk` from `Mathilde411:trunk` Closed 12 Conversations 1 Commit 0 Checks 7 Files changed +198 -5

add Dynarray to the stdlib. #11563 c-cube wants to merge 29 commits into `ocaml:trunk` from `c-cube:dyn-array` Closed 92 Conversations 29 Commits 0 Checks 10 Files changed +792 -1

Overview

This is a (work in progress) PR to add dynamic arrays ("vectors") to the stdlib. The module name is `Dyn_array`, which, as some people pointed out, is more correct than `vector`. For now the implementation is pure OCaml. I discussed with [@Octachron](#) about ways to implement some filling functions in C, but I now think it might not be worth it after he pointed out some design constraints newly imposed by multicore.

A lot of the API mimics `Array`, when it does not change the length of the dynamic array.

Reviewers

- gasche
- +5 more reviewers
- bluddy
- dbuenzli
- hhugo
- silene
- gadmm

Assignees

No one—[assign yourself](#)

Opened: Nov 15, 2019, **Closed:** Nov 15 2019

Implementation rather naive, room for improvements

Opened: Sep 25, 2022, **Closed:** Jan 18, 2023

Clean API, *but* multicore safety, performance

A small(?) change — Dynamic Arrays

The image displays three overlapping GitHub pull request (PR) cards, illustrating the progression of dynamic arrays in OCaml. The top card, titled "Added dynamic arrays #9122", is marked as "Closed" and shows a merge of 1 commit from Mathilde411:trunk into ocaml:trunk, with 7 files changed and a net change of +198 lines. The middle card, titled "add Dynarray to the stdlib. #11563", is also "Closed" and shows a merge of 29 commits from c-cube:dyn-array into ocaml:trunk, with 10 files changed and a net change of +792 lines. The bottom card, titled "Dynarrays, boxed #11882", is marked as "Merged" and shows a merge of 51 commits from gasche:dyn-array-boxed into ocaml:trunk, with 18 files changed and a net change of +2,108 lines. This card includes a comment from gasche dated Jan 11, 2023, and a list of reviewers: alainfrisch, damiendoligez, and Octachron, all with green checkmarks indicating approval. A section titled "Current status of this PR" is also visible, noting it was last updated on September 27th, 2023.

Added dynamic arrays #9122

Closed Mathilde411 wants to merge 1 commit into `ocaml:trunk` from `Mathilde411:trunk`

Conversation 12 Commits 1 Checks 0 Files changed 7 +198 -5

add Dynarray to the stdlib. #11563

Closed c-cube wants to merge 29 commits into `ocaml:trunk` from `c-cube:dyn-array`

Conversation 92 Commits 29 Checks 0 Files changed 10 +792 -1

Dynarrays, boxed #11882

Merged gasche merged 51 commits into `ocaml:trunk` from `gasche:dyn-array-boxed` on Oct 21, 2023

Conversation 342 Commits 51 Checks 0 Files changed 18 +2,108 -173

gasche commented on Jan 11, 2023 • Member

Current status of this PR

(last updated: September 27th 2023)

Reviewers

- alainfrisch
- damiendoligez
- Octachron
- +6 more reviewers
- dbuenzli

Opened: Nov 15, 2019, **Closed:** Nov 15 2019

Implementation rather naive, room for improvements

Opened: Sep 25, 2022, **Closed:** Jan 18, 2023

Clean API, *but* multicore safety, performance

Opened: Jan 11, 2023, **Merged:** Oct 21, 2023

Clean API *and* simple implementation

A small(?) change — Dynamic Arrays

Added dynamic arrays #9122

Edit <> Code

Closed Mathilde411 wants to merge 1 commit into `ocaml:trunk` from `Mathilde411:trunk`

Conversation 12 Commits 1 Checks 0 Files changed 7

+198 -5

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Edit <> Code

Closed c-cube wants to merge 29 commits into `ocaml:trunk` from `c-cube:dyn-array`

Conversation 92 Commits 29 Checks 0 Files changed 10

+792 -1

Dynarrays, boxed #11882

Edit <> Code

Merged gasche merged 51 commits into `ocaml:trunk` from `gasche:dyn-array-boxed` on Oct 21, 2023

Dynarrays, unboxed (with local dummies) #12885

Edit <> Code

Merged

gasche merged 9 commits into `ocaml:trunk` from `gasche:dynarray-unboxed-dummy` on May 2, 2024

Conversation 53 Commits 9 Checks 0 Files changed 6

+455 -235

gasche commented on Jan 5, 2024 • edited

Member

Reviewers

Opened: Nov 15, 2019, **Closed:** Nov 15 2019

Implementation rather naive, room for improvements

Opened: Sep 25, 2022, **Closed:** Jan 18, 2023

Clean API, *but* multicore safety, performance

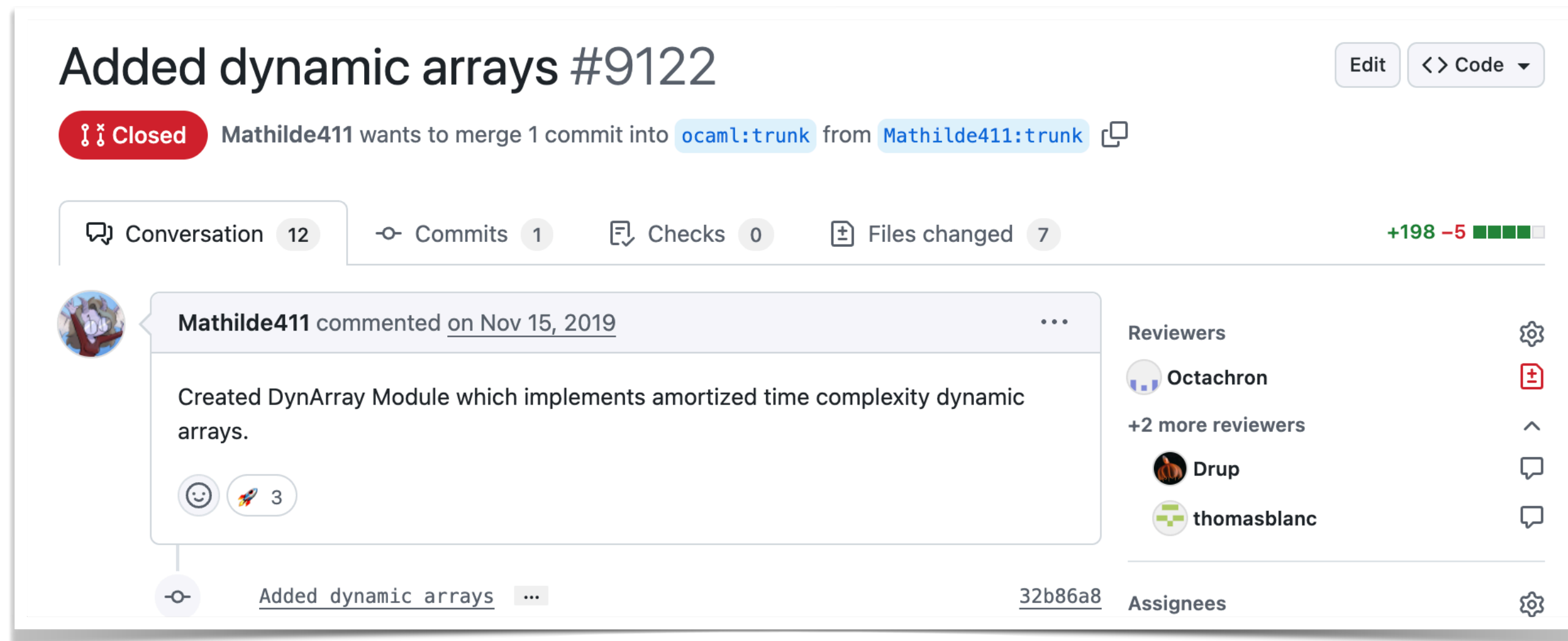
Opened: Jan 11, 2023, **Merged:** Oct 21, 2023

Clean API *and* simple implementation

Opened: Jan 5, 2024, **Merged:** May 2, 2024

Clean API and *optimised* implementation

Dynamic Arrays



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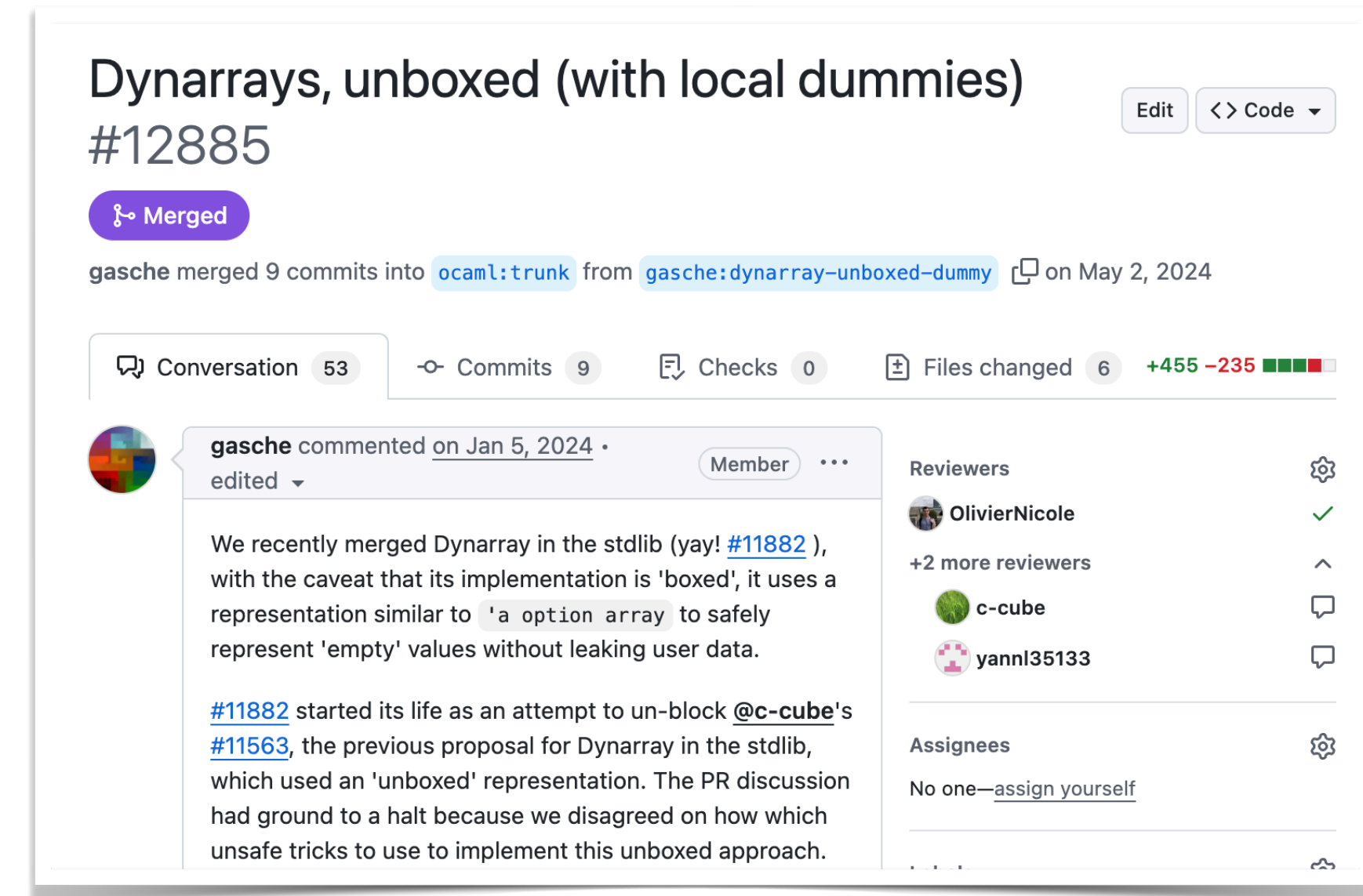
Conversation 12 Commits 1 Checks 0 Files changed 7 +198 -5

Mathilde411 commented on Nov 15, 2019

Created DynArray Module which implements amortized time complexity dynamic arrays.

Reviewers: Octachron, Drup, thomasblanc

Assignees: 32b86a8



Dynarrays, unboxed (with local dummies) #12885 Edit <> Code

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Conversation 53 Commits 9 Checks 0 Files changed 6 +455 -235

gasche commented on Jan 5, 2024

We recently merged Dynarray in the stdlib (yay! [#11882](#)), with the caveat that its implementation is 'boxed', it uses a representation similar to 'a option array' to safely represent 'empty' values without leaking user data.

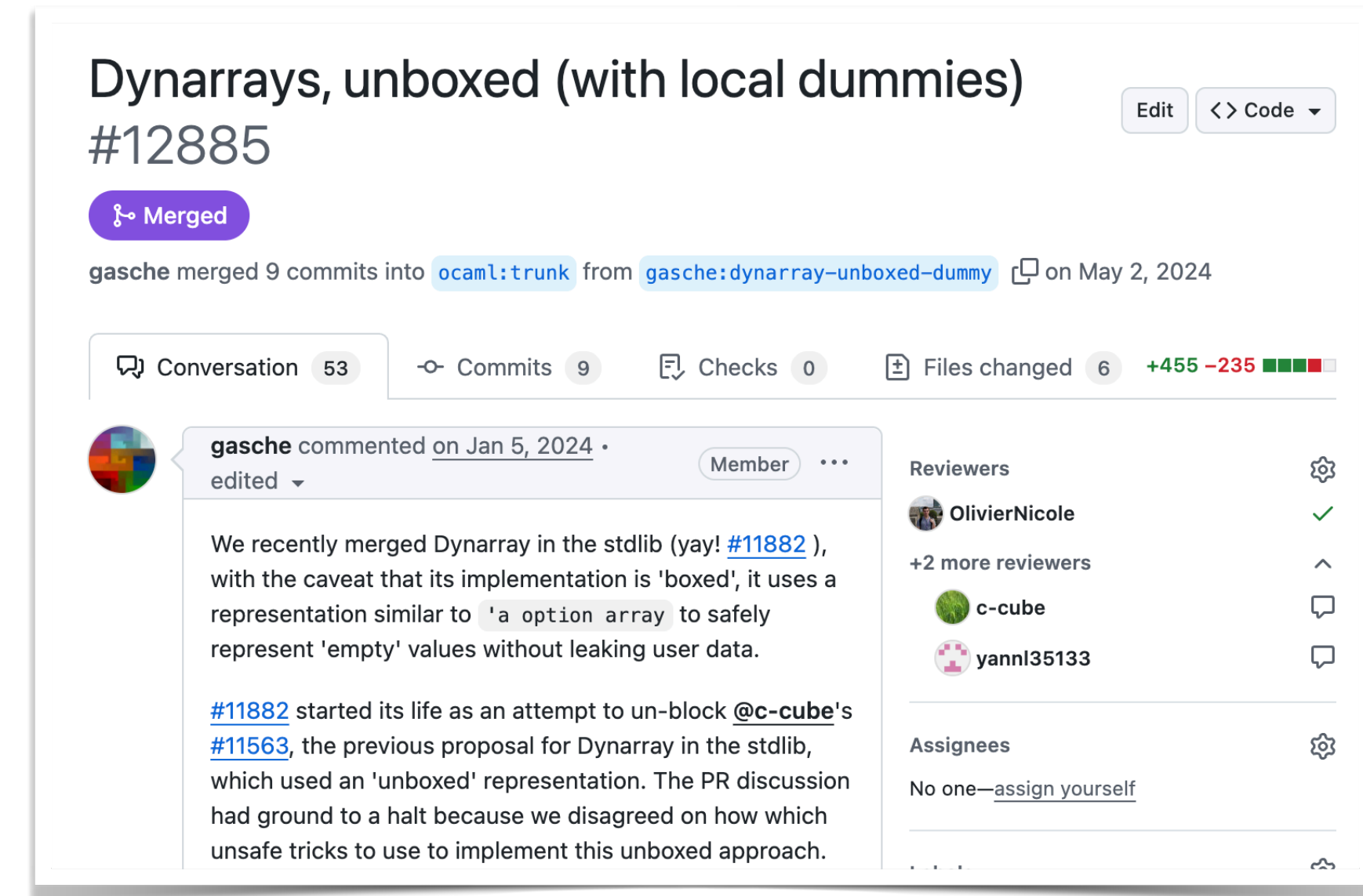
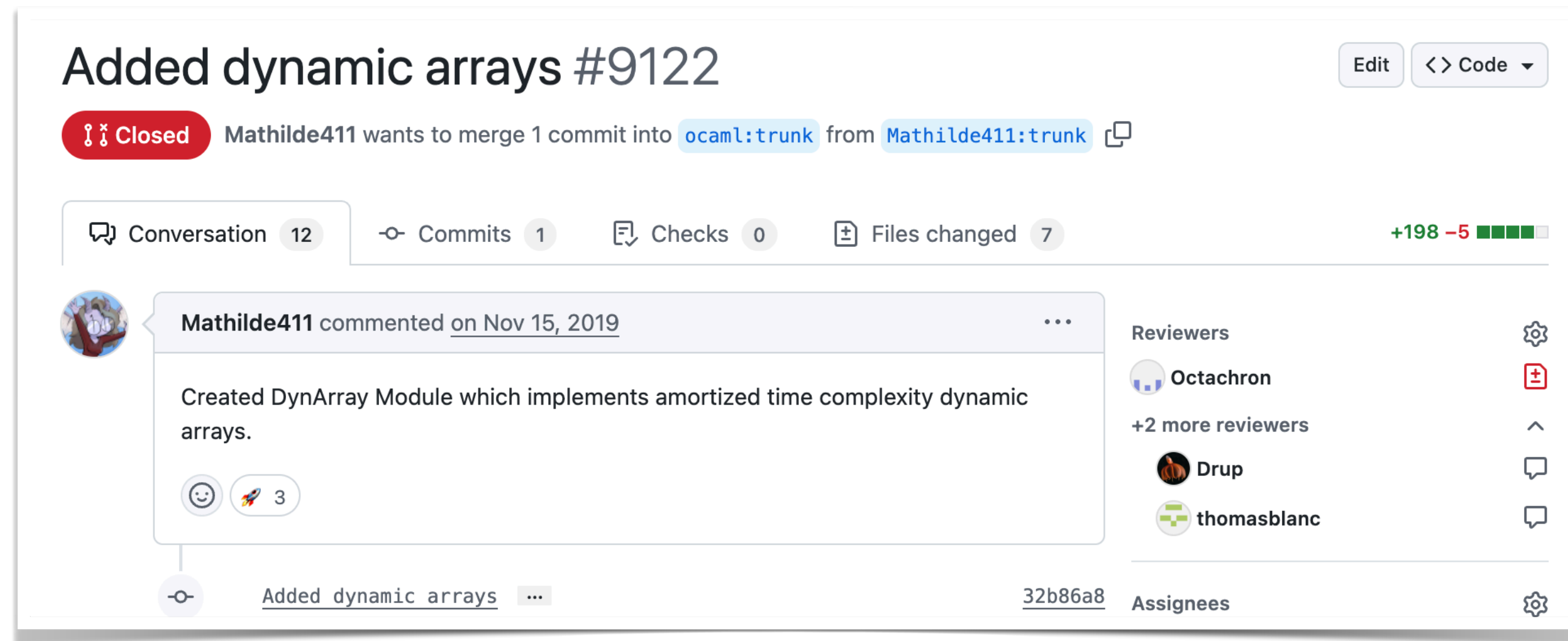
[#11882](#) started its life as an attempt to un-block @c-cube's [#11563](#), the previous proposal for Dynarray in the stdlib, which used an 'unboxed' representation. The PR discussion had ground to a halt because we disagreed on how which unsafe tricks to use to implement this unboxed approach.

Reviewers: OlivierNicole, c-cube, yannl35133

Assignees: No one—[assign yourself](#)

- **Summary**
 - Proposed — Nov 2019, Merged — (PR#1) Jan 2024; (PR#2) May 2024
 - Initially — 198 loc, finally — ~2500 loc
 - 500+ comments in the various PRs

Dynamic Arrays



- **Summary**

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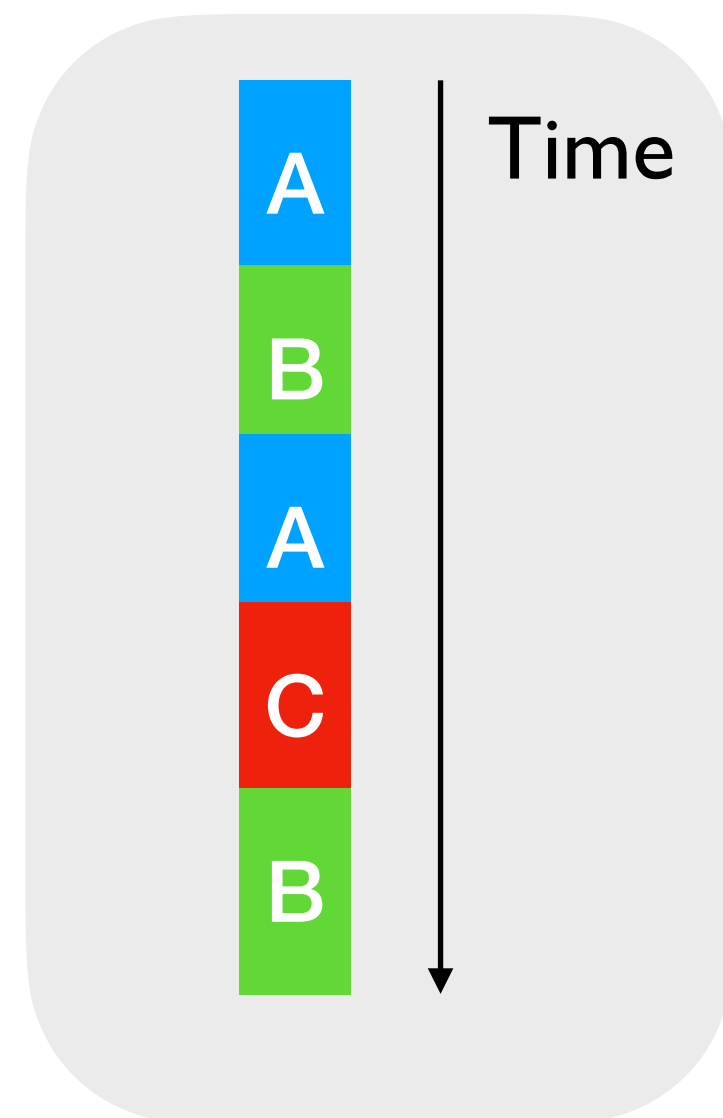
- **Worth it?**

- **Yes!** Should work for the next couple of decades.
- Harder to undo changes after the release.

A large change — Multicore OCaml

- Native support for concurrency and parallelism to OCaml

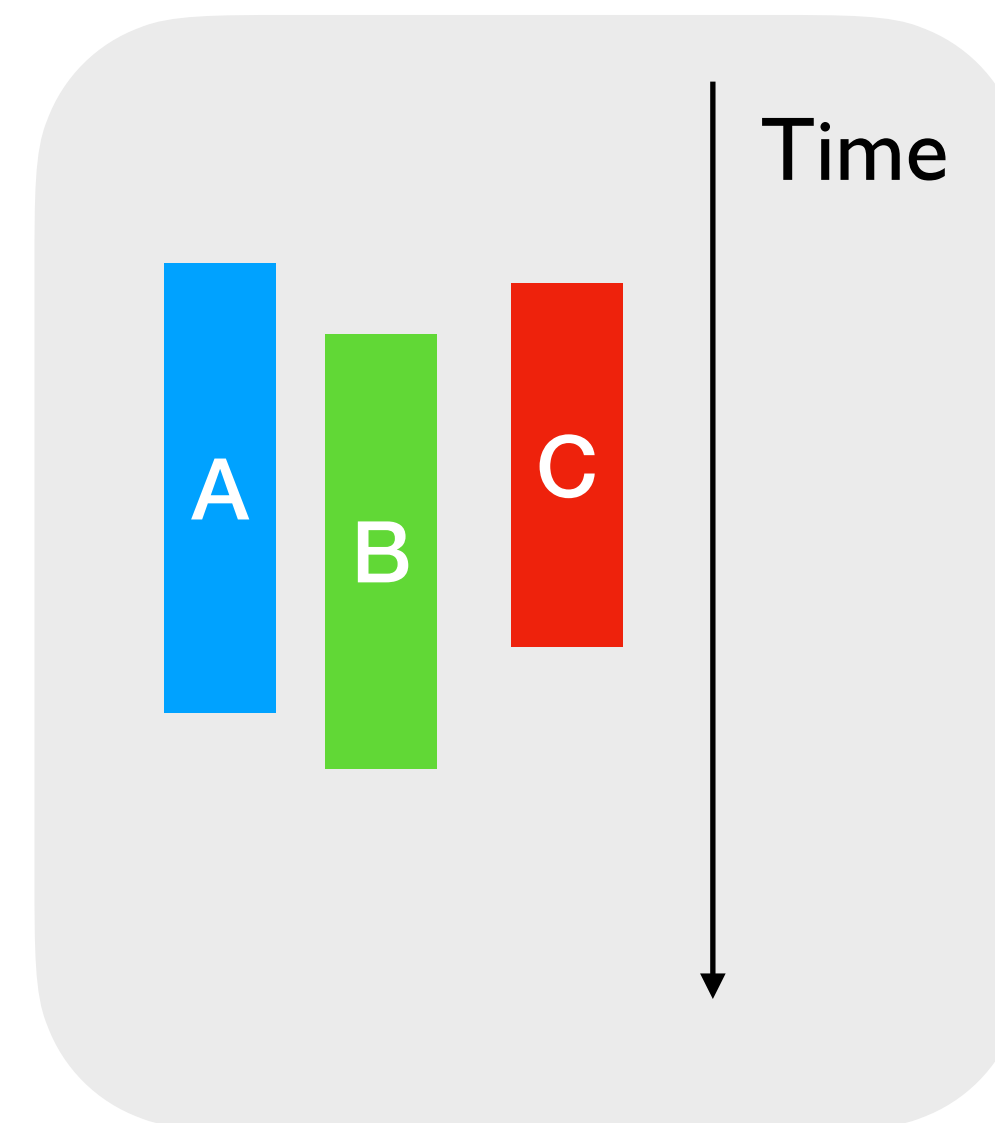
Concurrency



*Interleaved
execution*

Effect Handlers

Parallelism



*Simultaneous
execution*

Domains

Challenges

Challenges

- A new multicore garbage collector and multicore runtime system
 - *Replacing a car engine with a new one!*

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Build credibility by *publishing key results* and *rigorous evaluation*

Starting out

Multicore OCaml

Stephen Dolan

Leo White

Anil Madhavapeddy

Currently, threading is supported in OCaml only by means of a global lock, allowing at most thread to run OCaml code at any time. We present ongoing work to design and implement an OCaml runtime capable of shared-memory parallelism.

1 Introduction

Adding shared-memory parallelism to an existing lan-

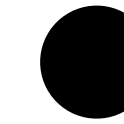
all objects reachable from it to be promoted to the shared heap en masse. Unfortunately this eagerly promotes many objects that were never really shared: just because an object is pointed to by a shared object does not mean another thread is actually going to attempt to access it.

Our design is similar but lazier, along the lines of the multicore Haskell work [2], where objects are promoted to the shared heap whenever another thread

OCaml Workshop **2014**

Starting out

Upstream
OCaml



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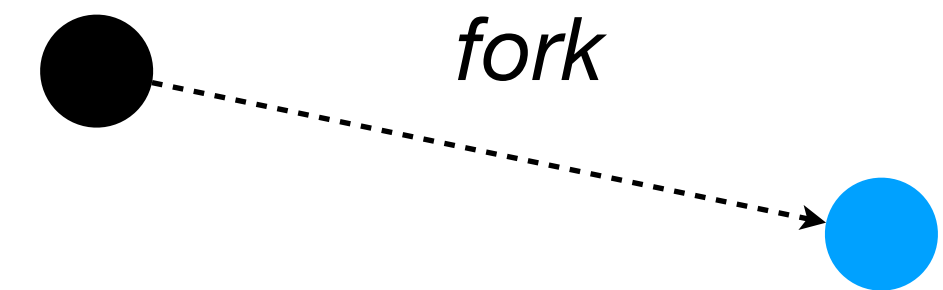
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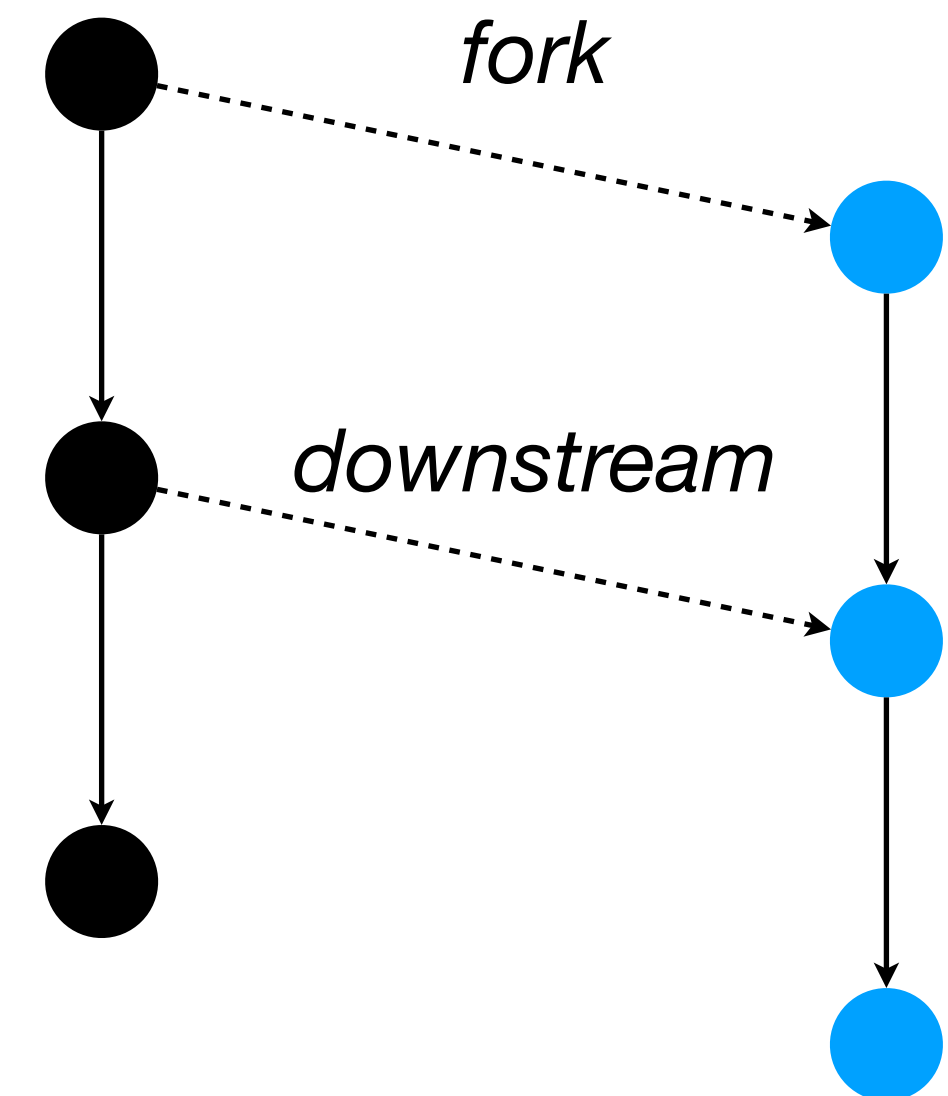
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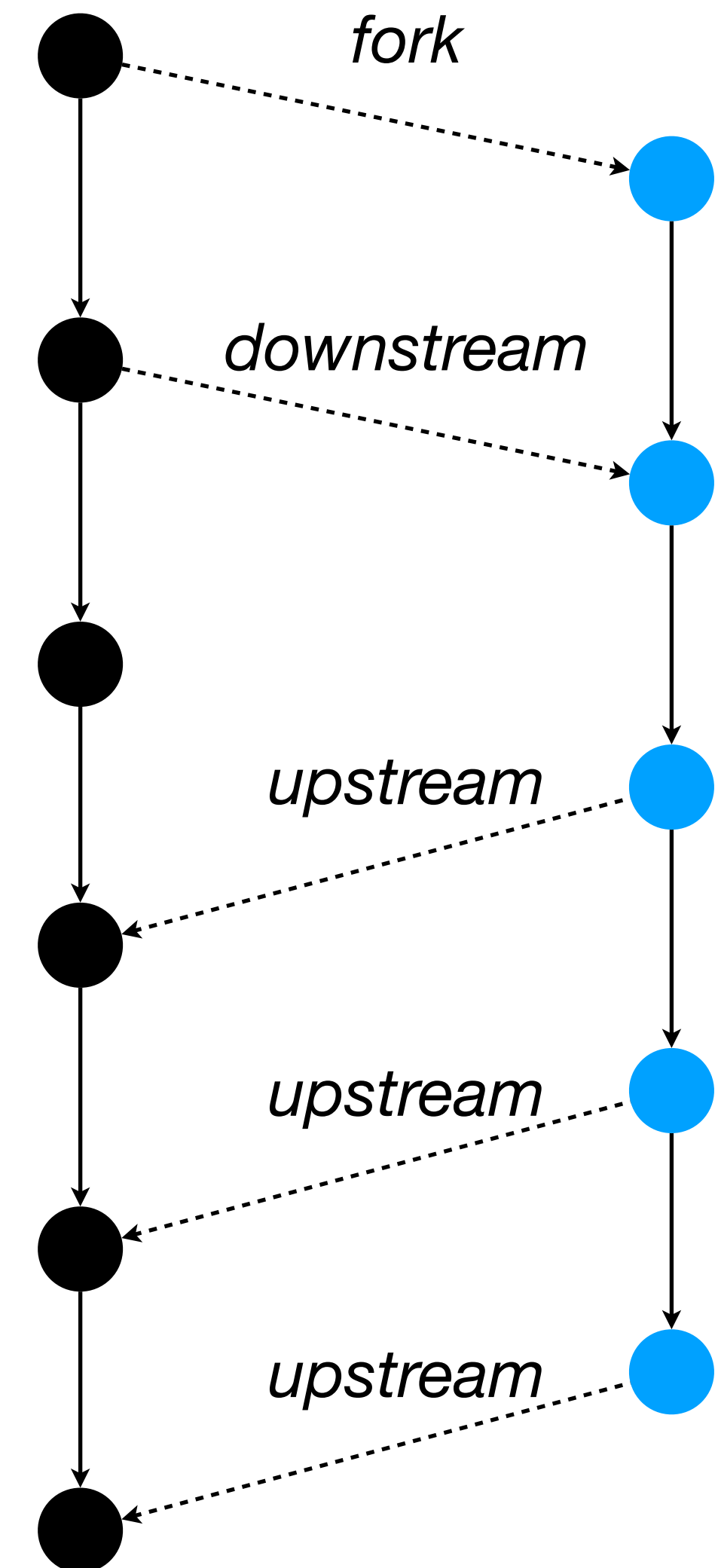
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OCaml Workshop 2014

Upstream
OCaml

Multicore
OCaml



Building confidence — Papers

Multicore GC and runtime system

Retrofitting Parallelism onto OCaml

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memory

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parallel

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Bounding Data Races in Space and Time

(Extended version, with appendices)

Retrofitting Effect Handlers onto OCaml

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Cambridge, UK
avsm2@cl.cam.ac.uk

Abstract

Effect handlers have been gathering momentum as a mechanism for modular programming with user-defined effects.

1 Introduction

Effect handlers [45] provide a modular foundation for user-defined effects. The key idea is to separate the definition of

Relaxed Memory Model

Concurrency story

Peer-reviewed ideas build confidence

Diving deeper — Concurrency

Retrofitting Effect Handlers onto OCaml

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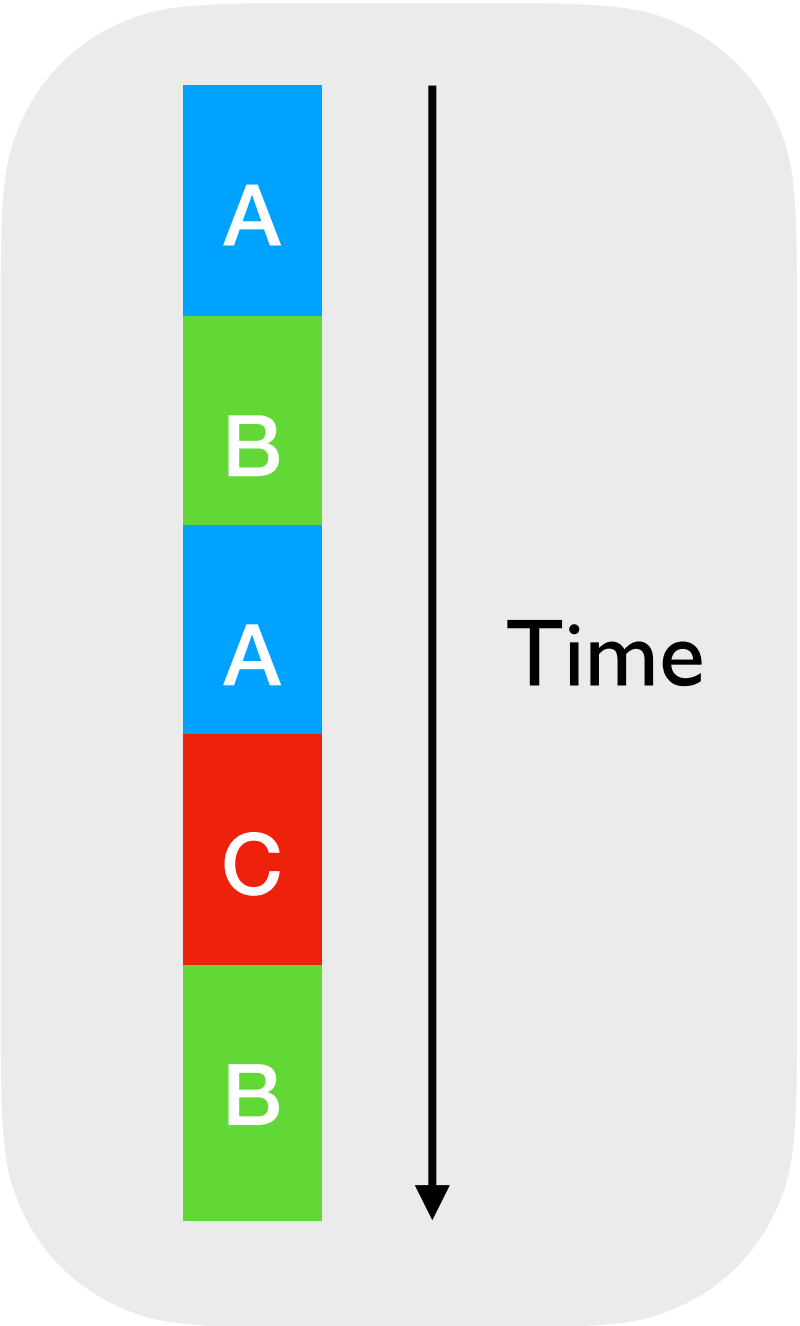
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Interleaved



Concurrent Programming

- Computations may be *suspended* and *resumed* later

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 - ✦ **async/await** — JavaScript, Python, Rust, C# 5.0, F#, Swift, ...
 - ✦ **generators** — Python, Javascript, ...
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 - ✦ **Lightweight threads/processes** — Haskell, Go, Erlang

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 - ✦ **futures & promises** — JavaScript, Swift, ...
 - ✦ **Lightweight threads/processes** — Haskell, Go, Erlang
- *Often include many different primitives in the same language!*
 - ✦ JavaScript has async/await, generators, promises, and callbacks

Don't want a **zoo** of primitives but
want ***expressivity***

Don't want a **zoo** of primitives but
want *expressivity*

What's the *smallest* primitive that
expresses *many* concurrency patterns?

Effect handlers

- A mechanism for programming with *user-defined effects*

Effect handlers

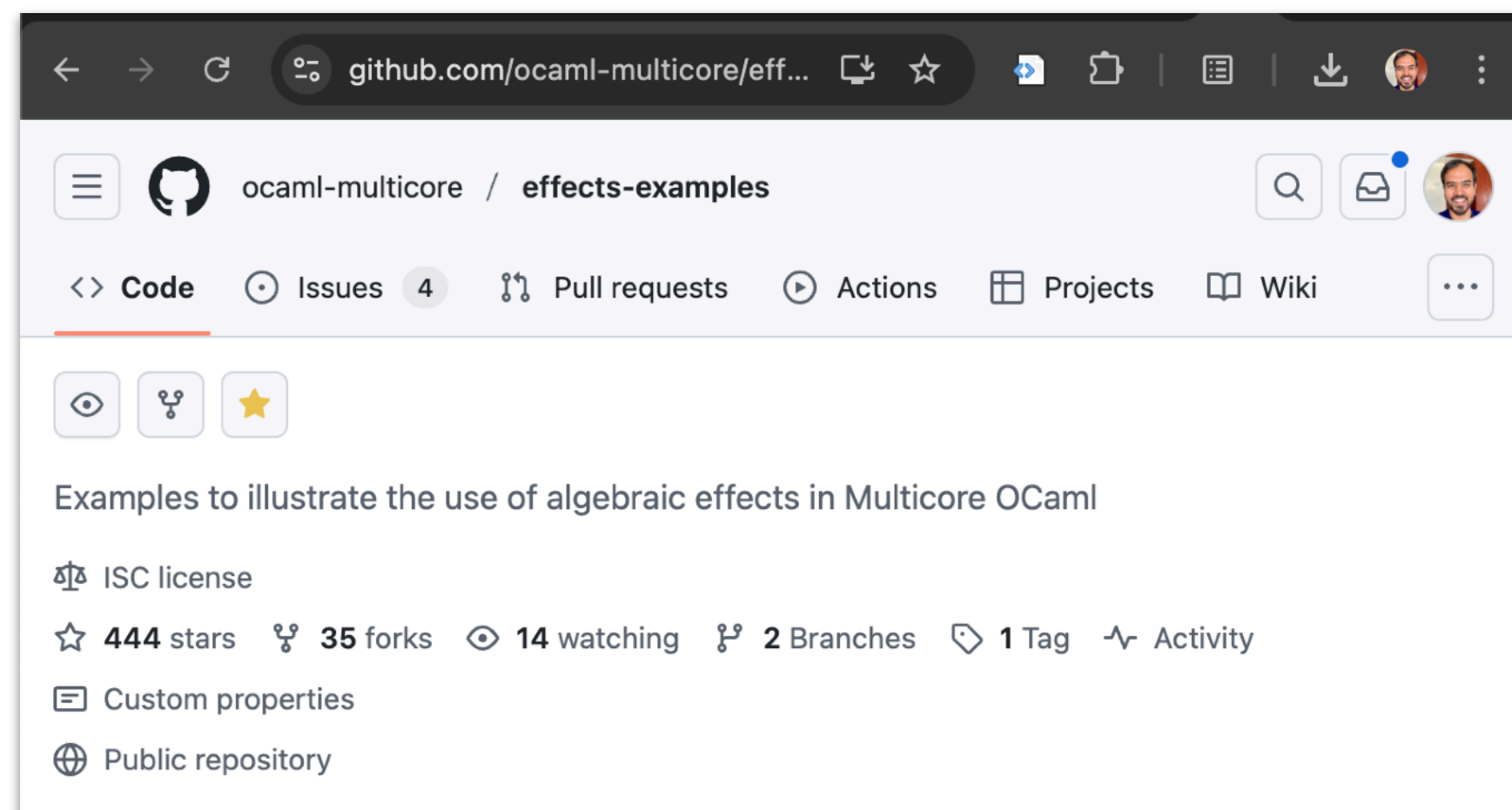
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- Direct-style asynchronous I/O
- Generators
- Resumable parsers
- Probabilistic Programming
- Reactive UIs
-

Effect handlers

```
type _ eff += E : string eff
```

```
let comp () =  
  print_string "0 "  
  print_string (perform E);  
  print_string "3 "
```

```
let main () =  
  try  
    comp ()  
  with effect E, k ->  
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Effect handlers

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effect declaration

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Effect handlers

effect declaration

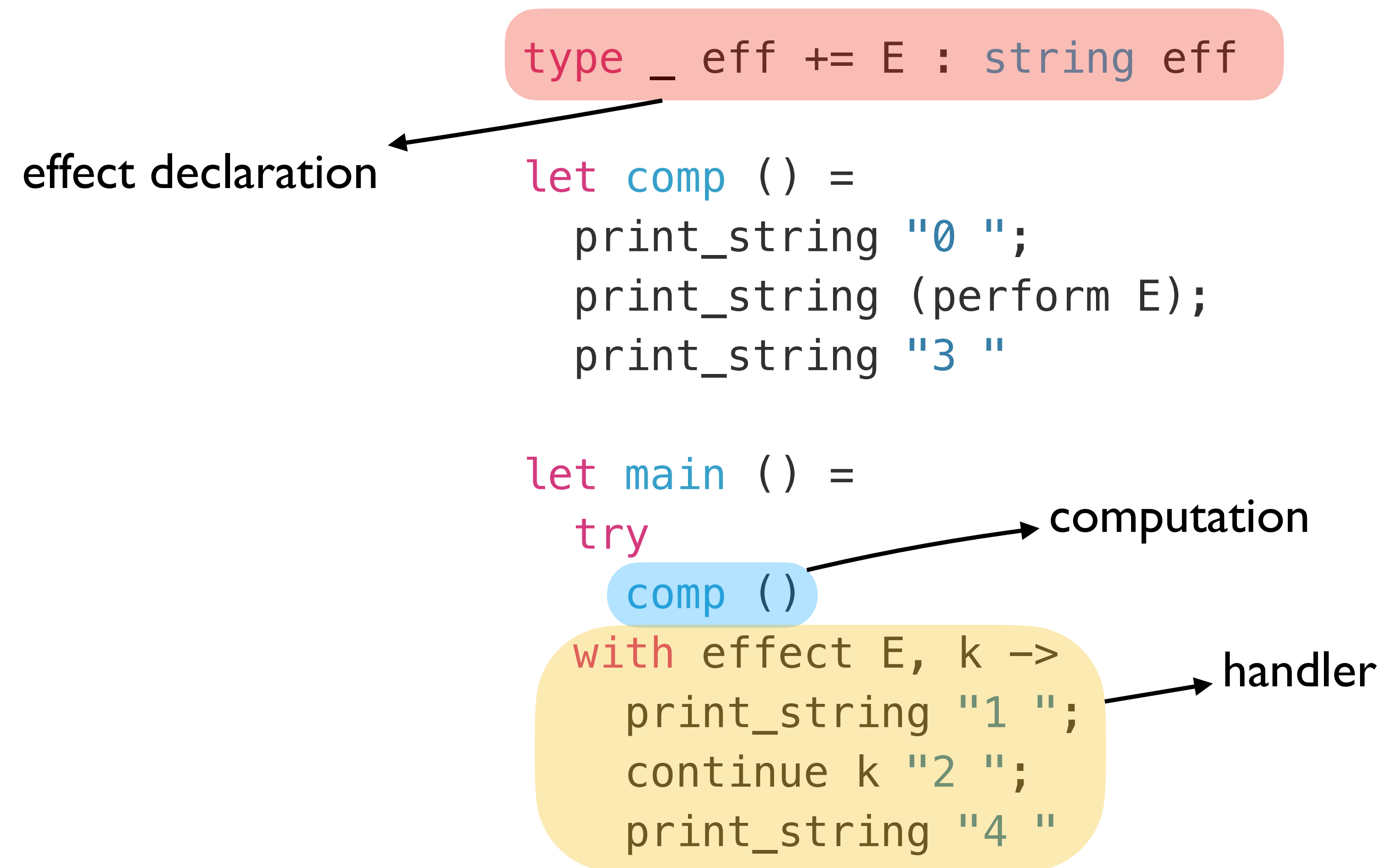
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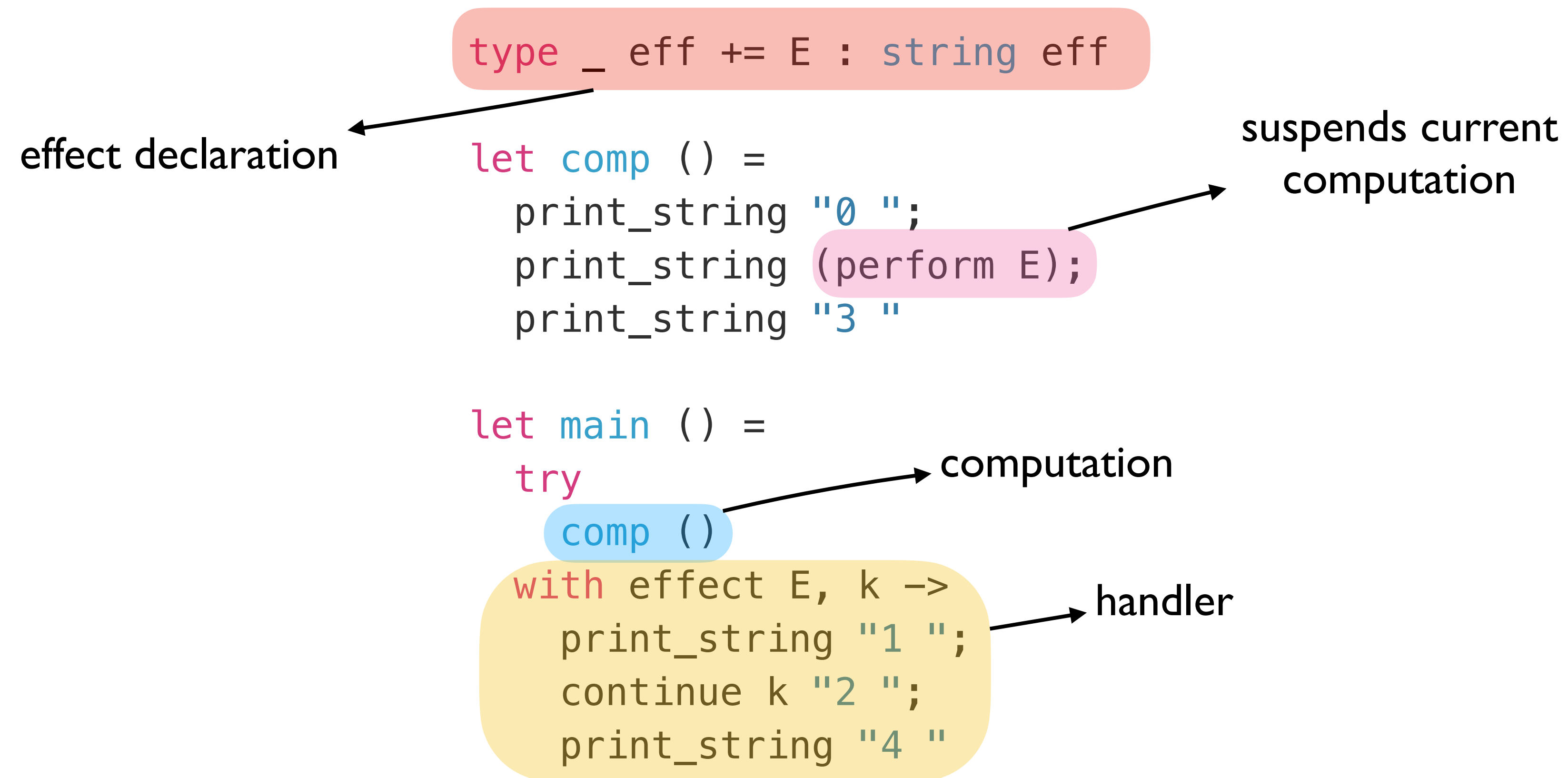
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computation

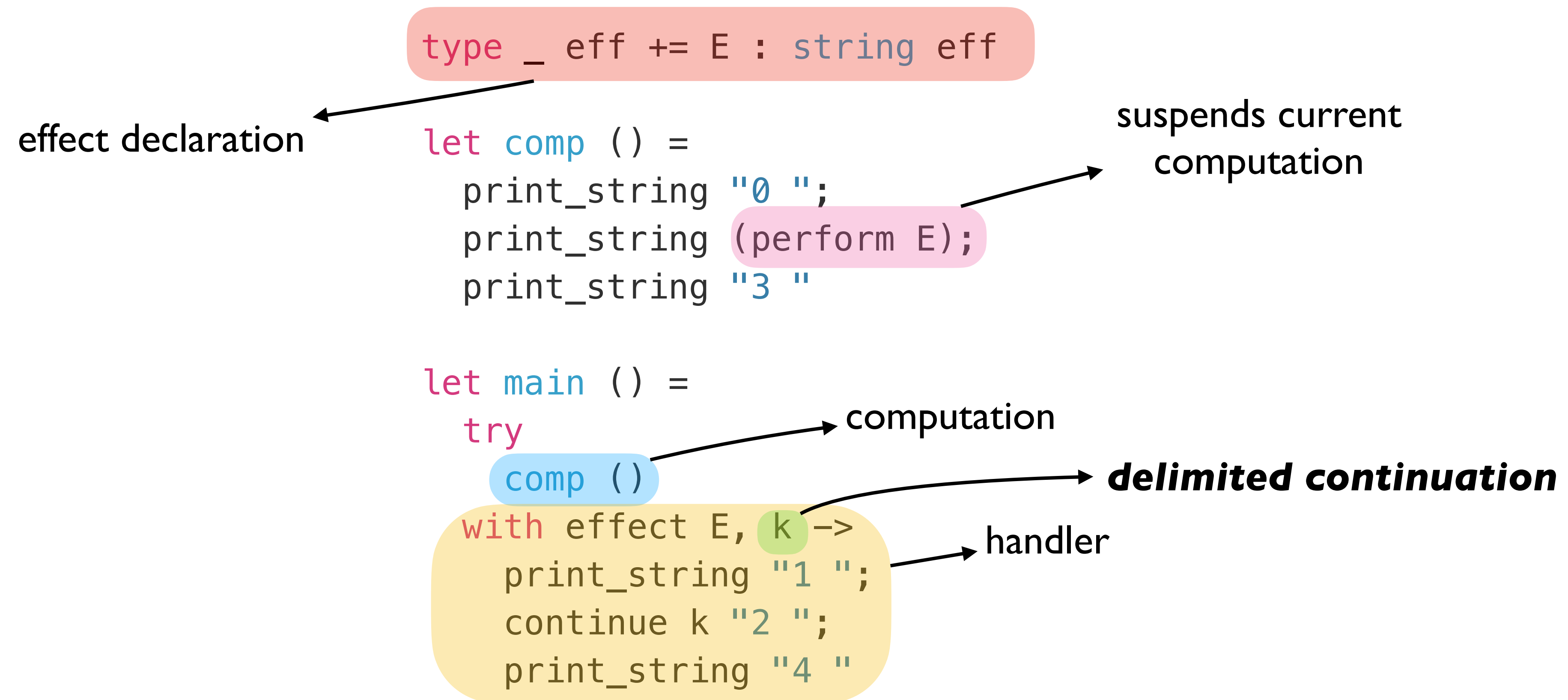
Effect handlers



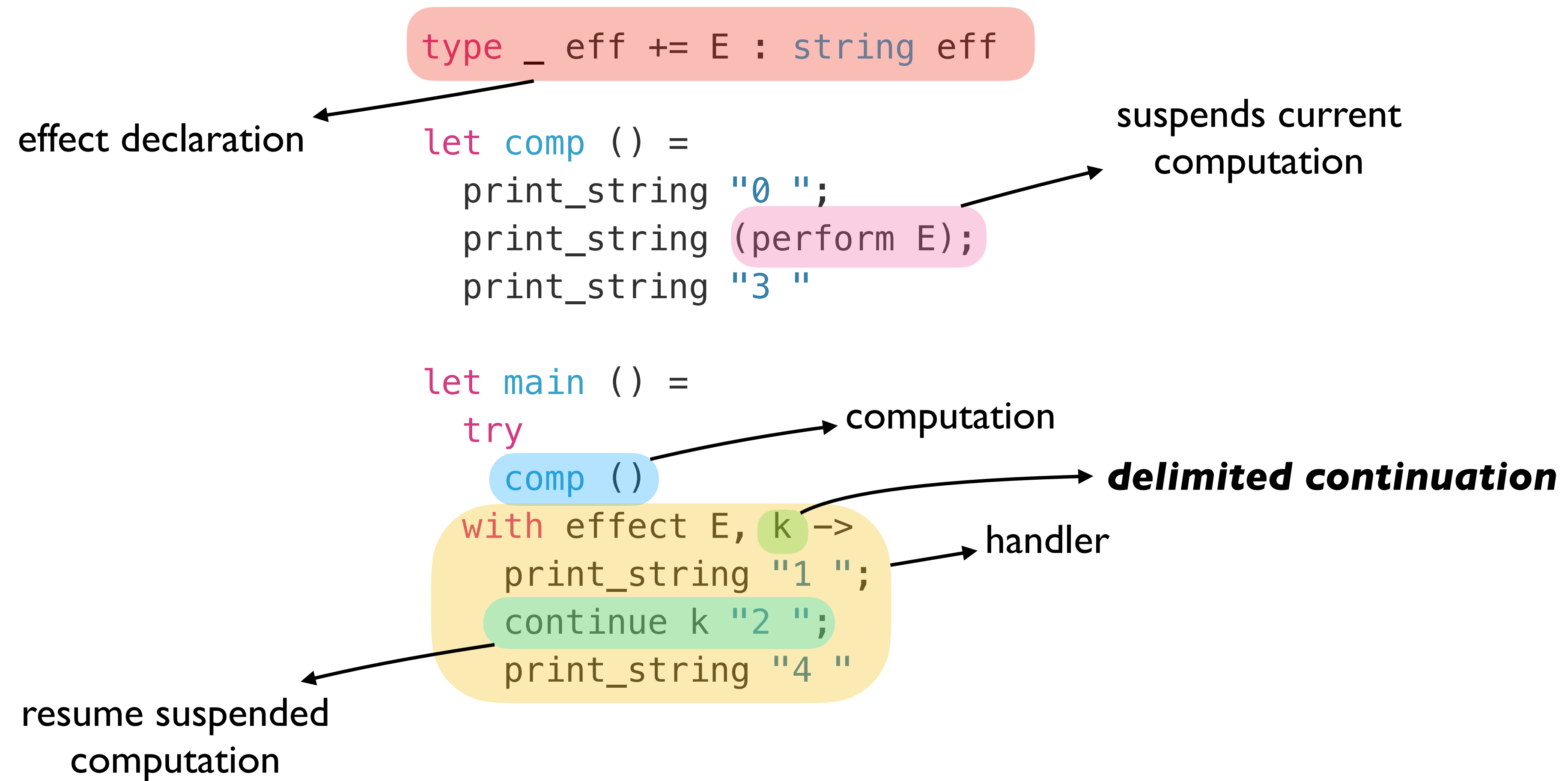
Effect handlers



Effect handlers



Effect handlers



Stepping through the example

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type 'a eff += E : string eff
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pc → let main () =  
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pc →

sp →



main

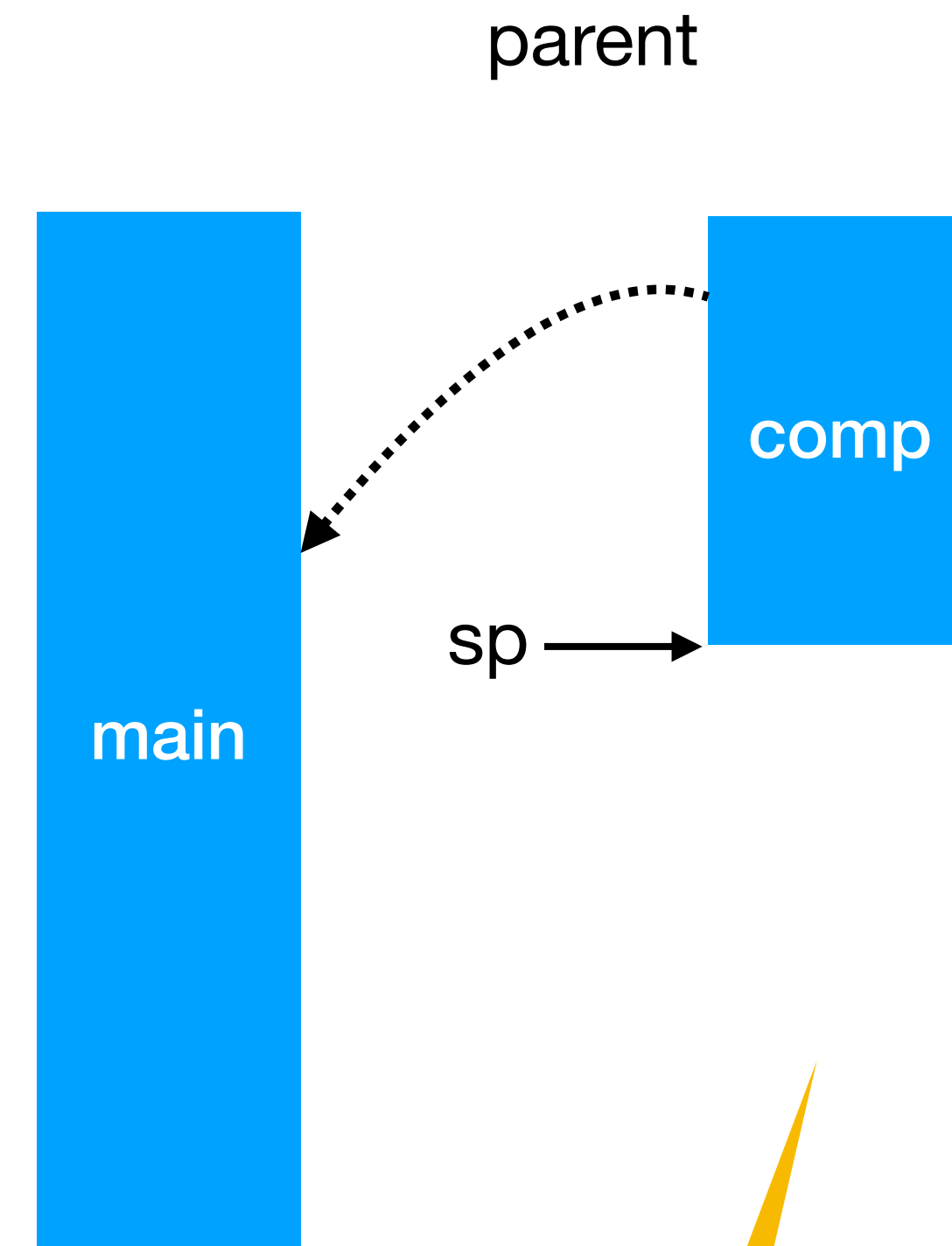
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pc →



Fiber: A piece of stack
+ effect handler

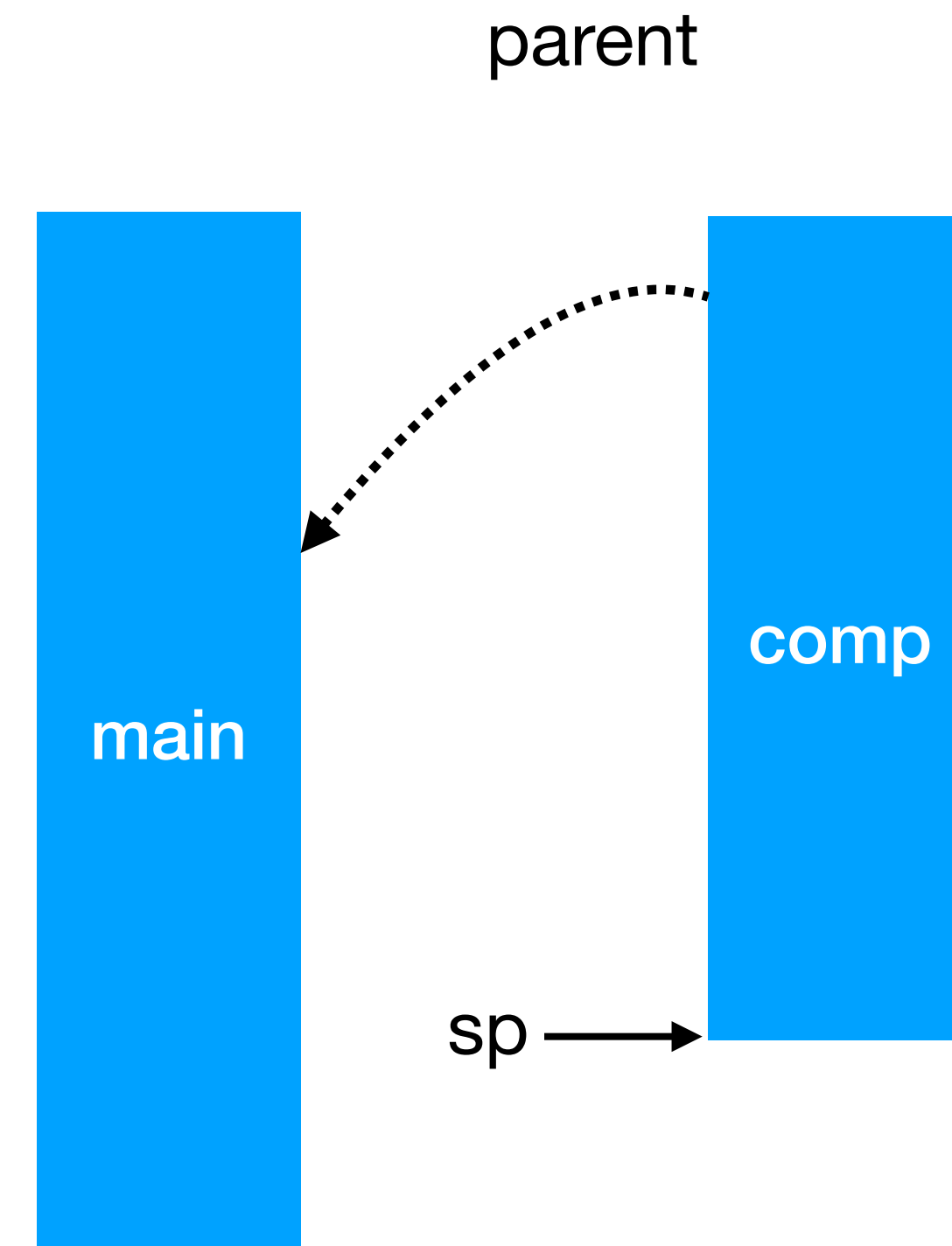
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pc →



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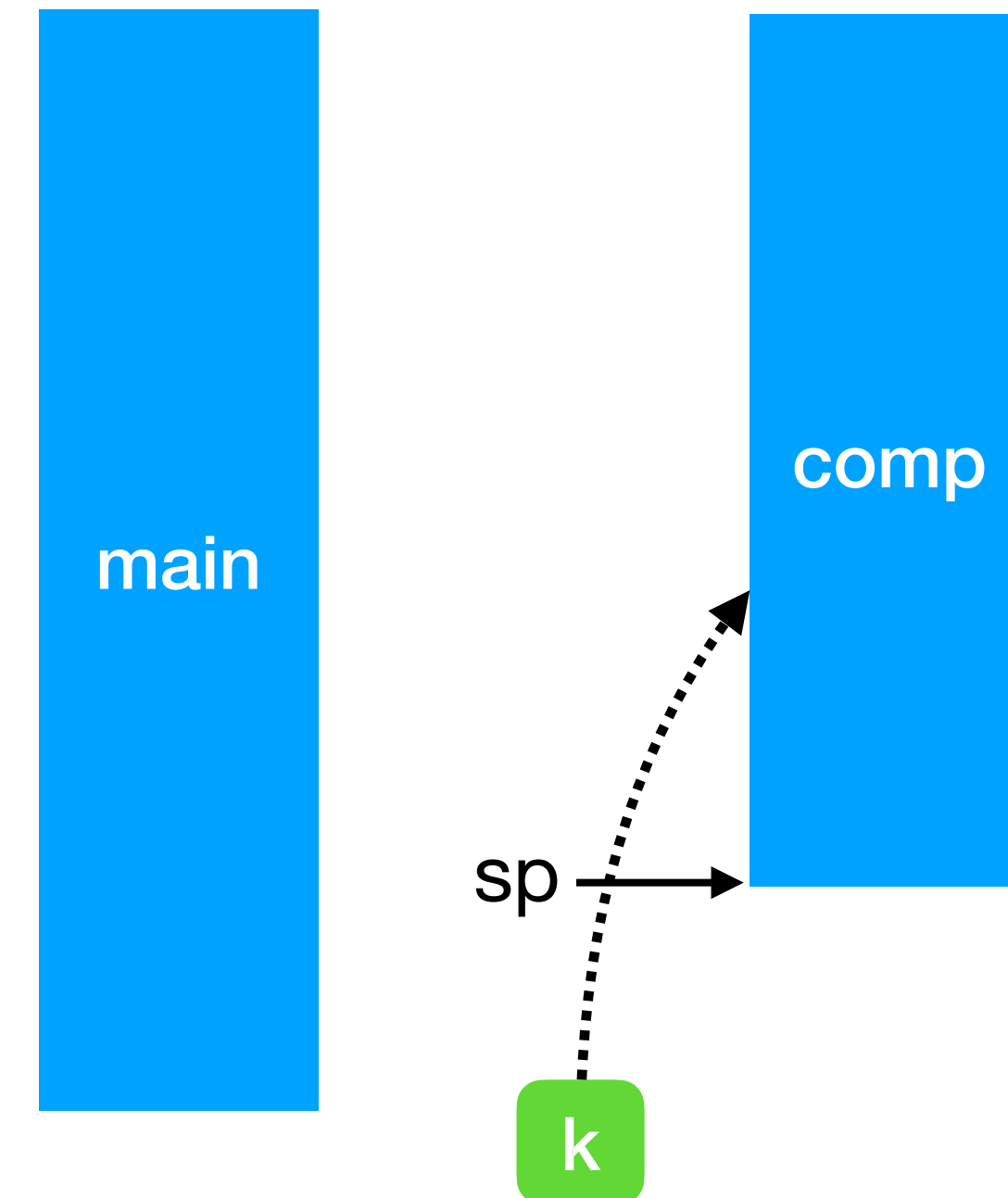
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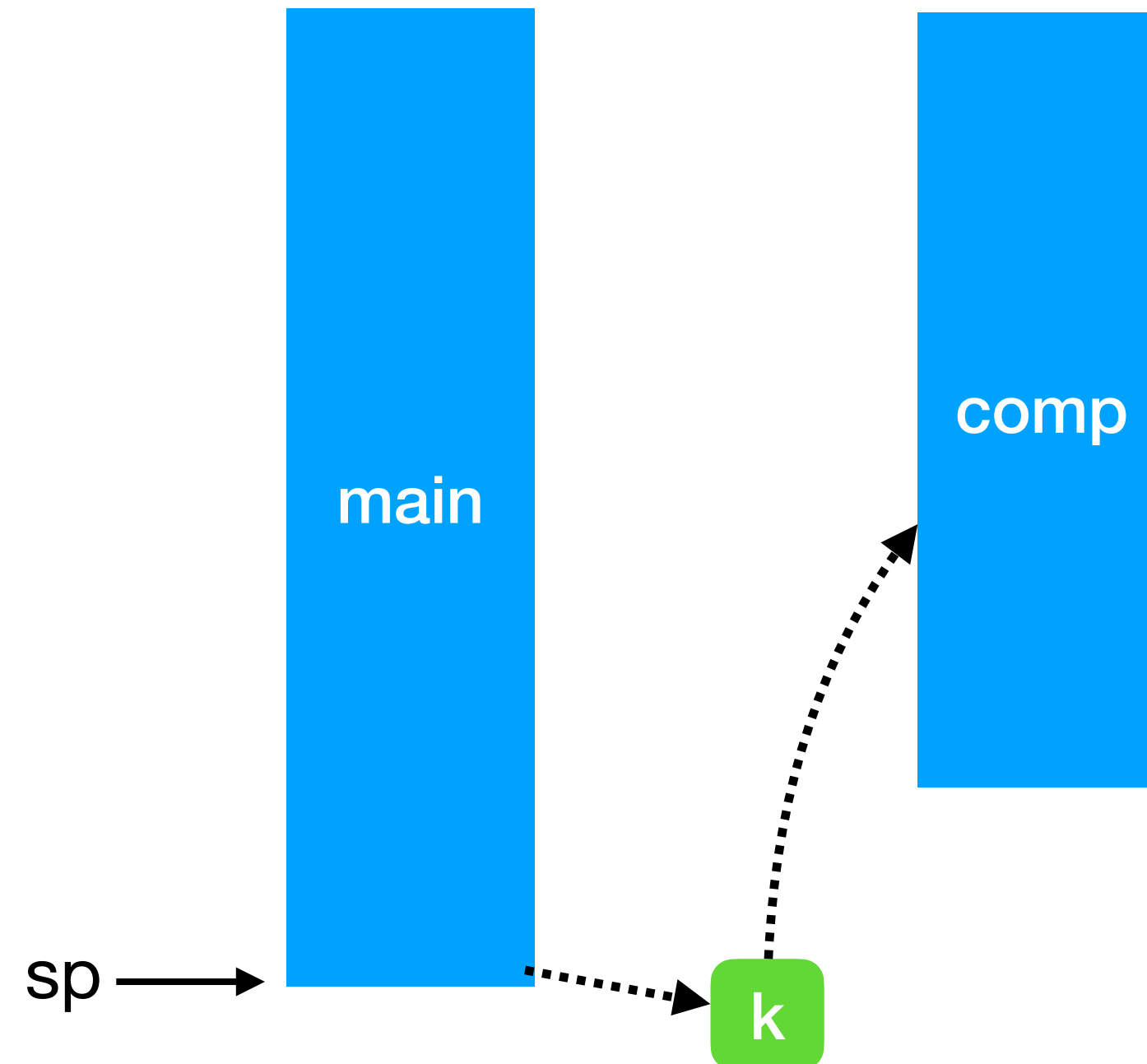
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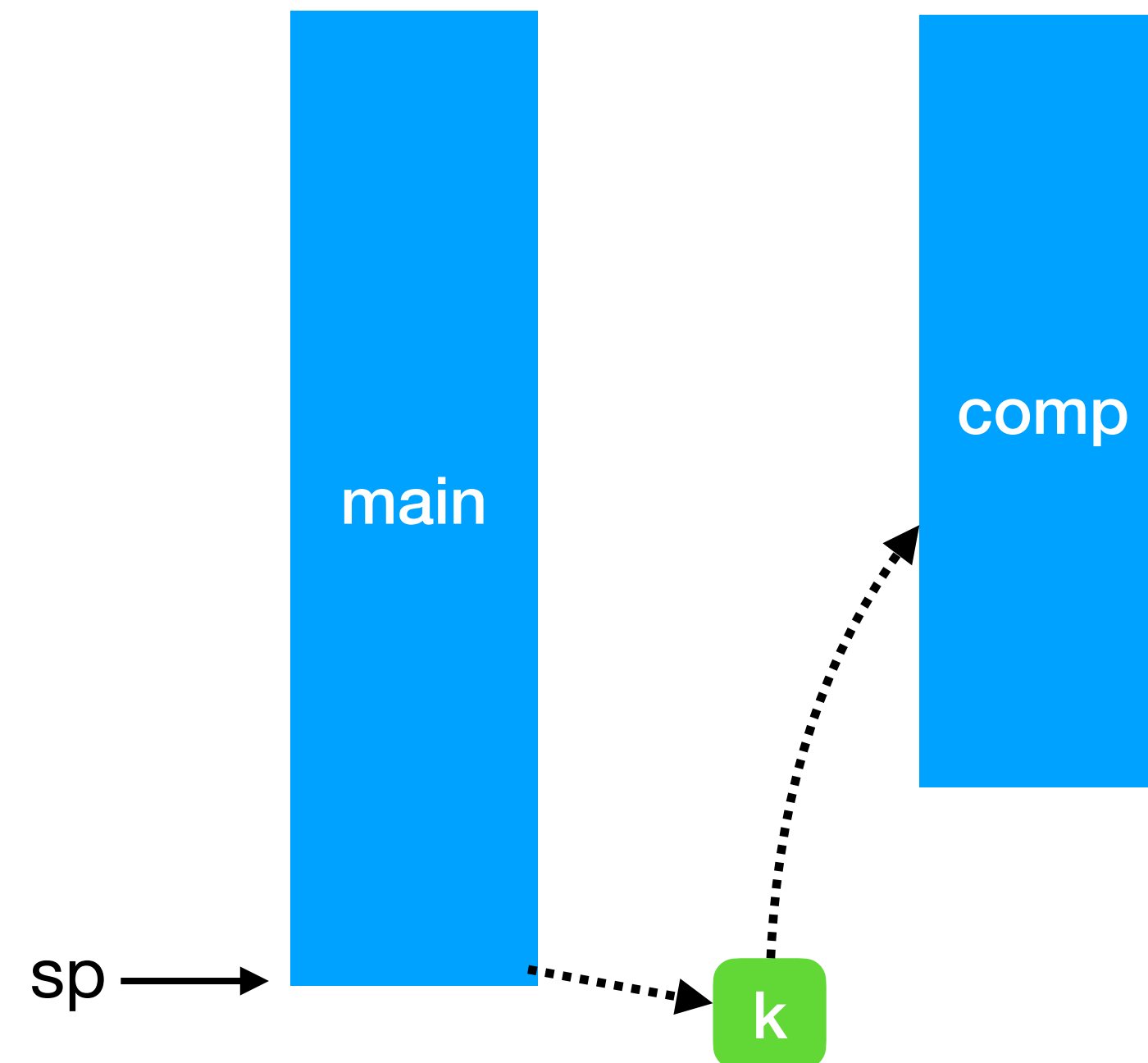
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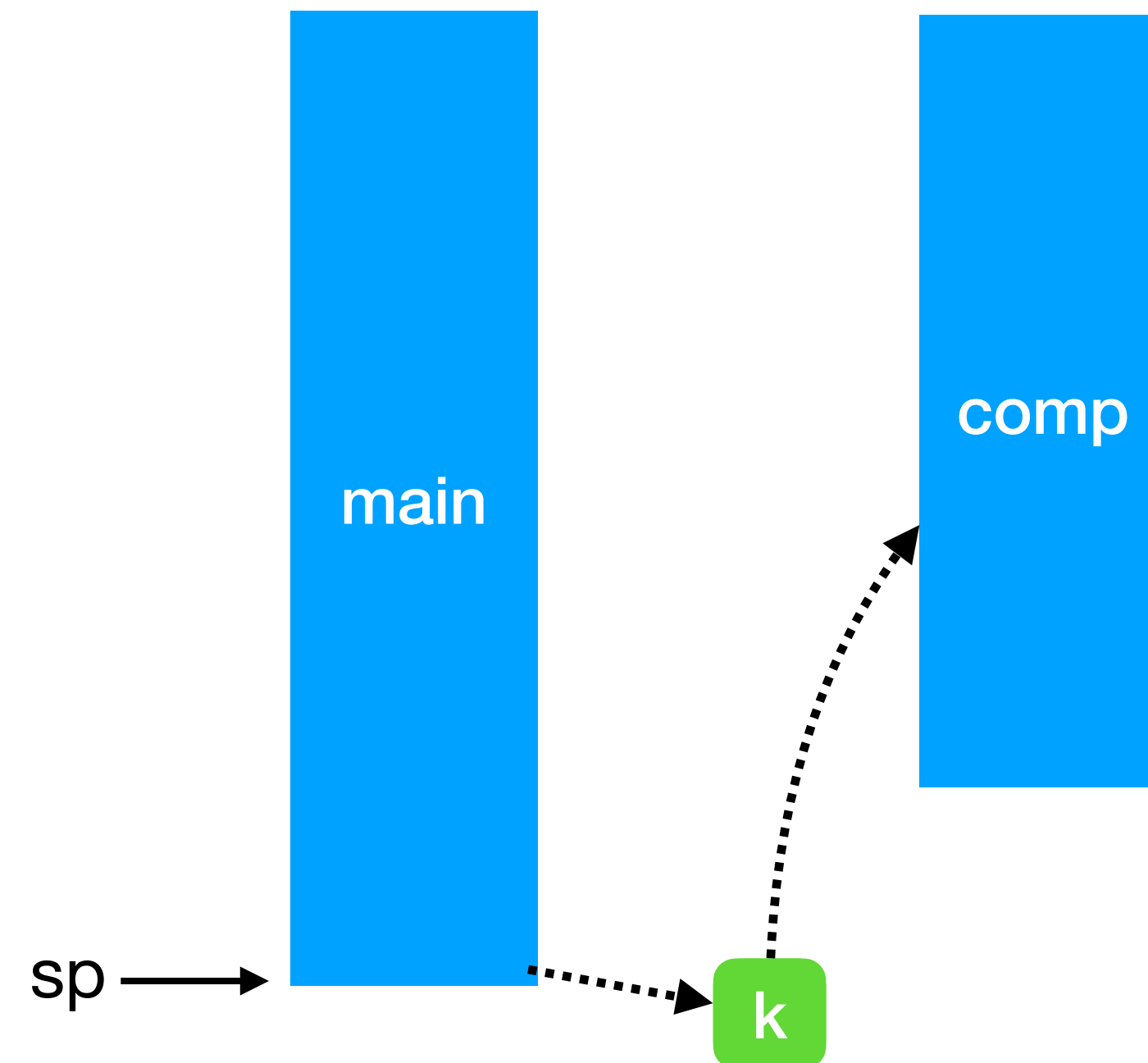
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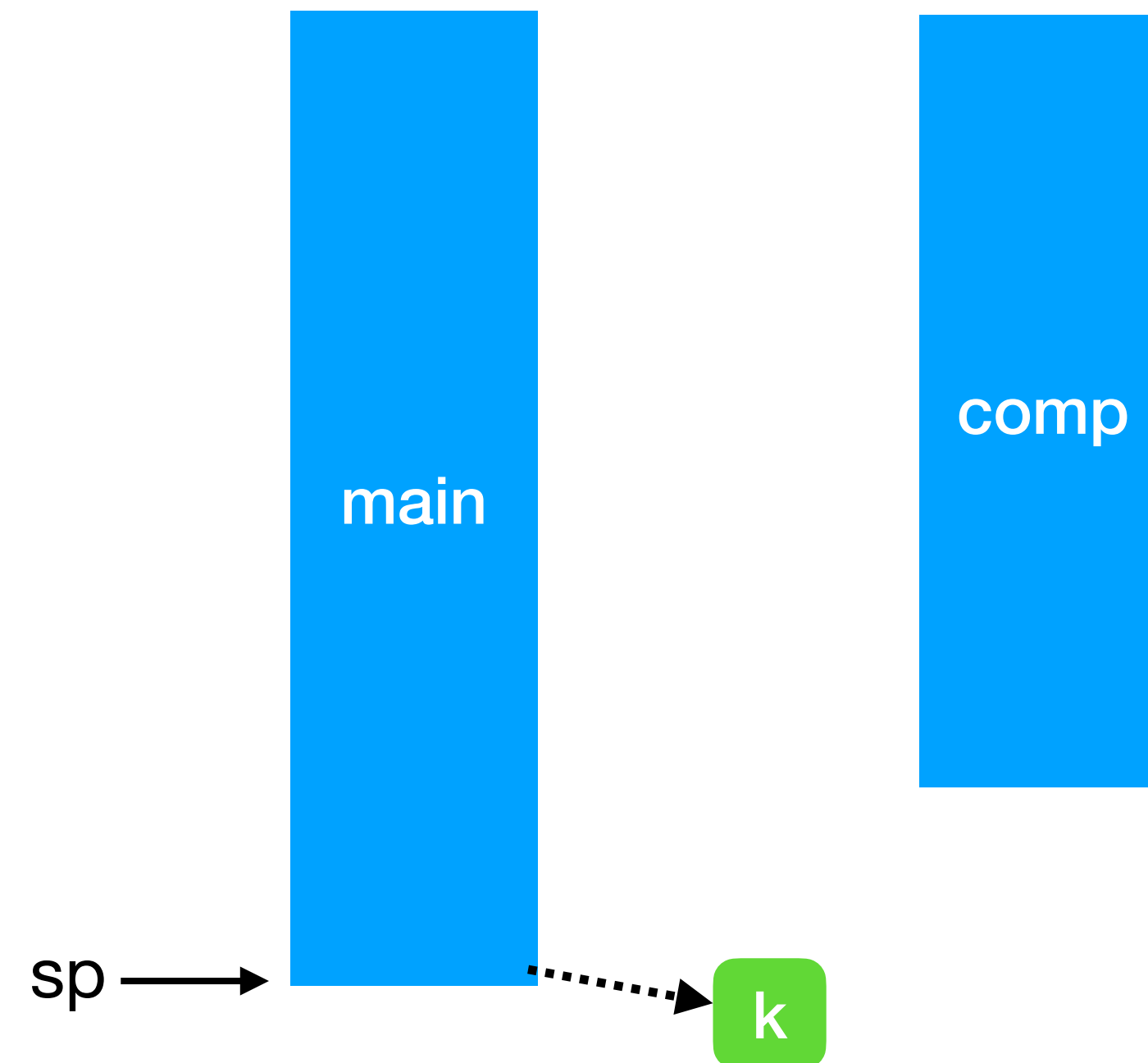
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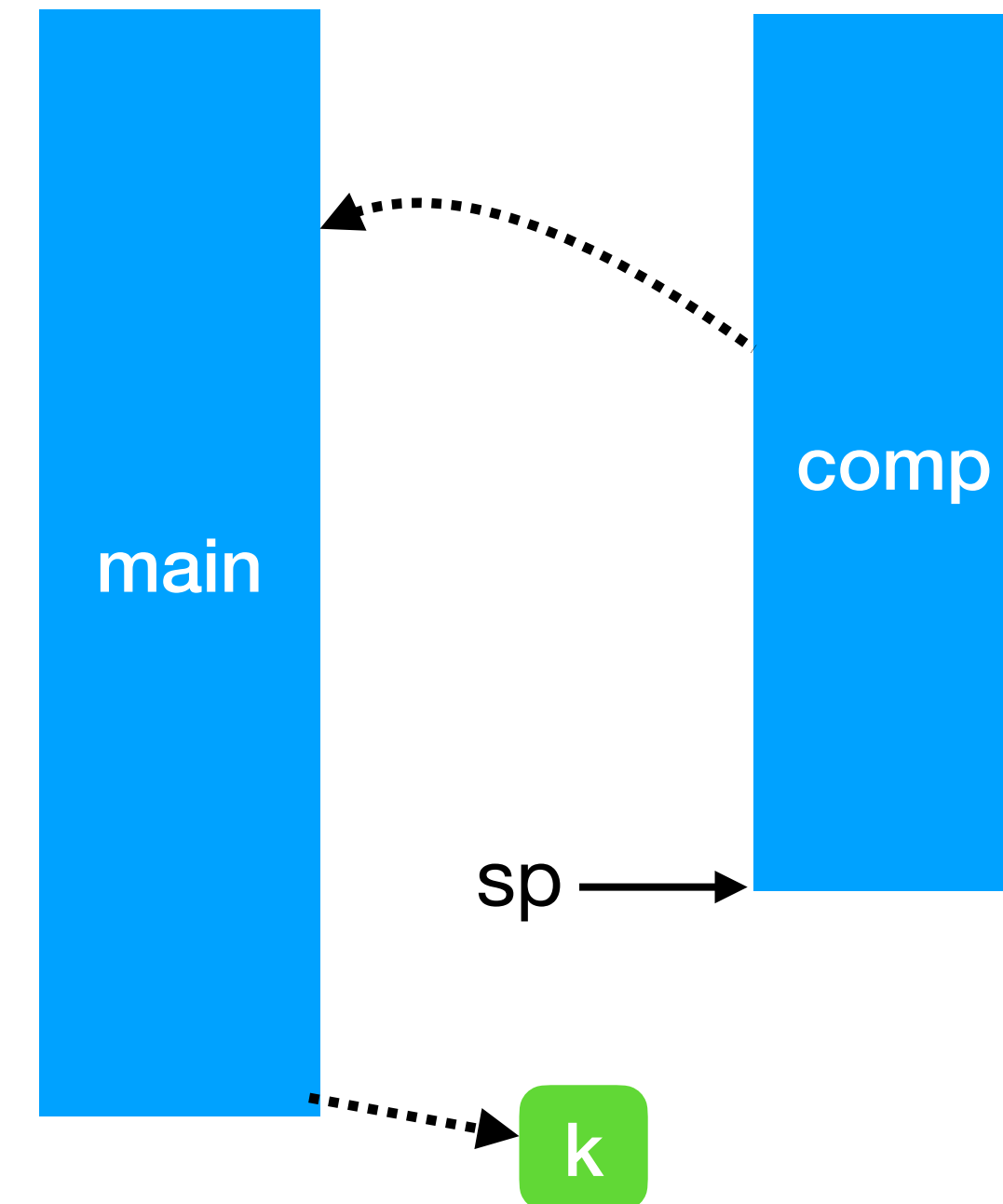
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1

parent



Stepping through the example

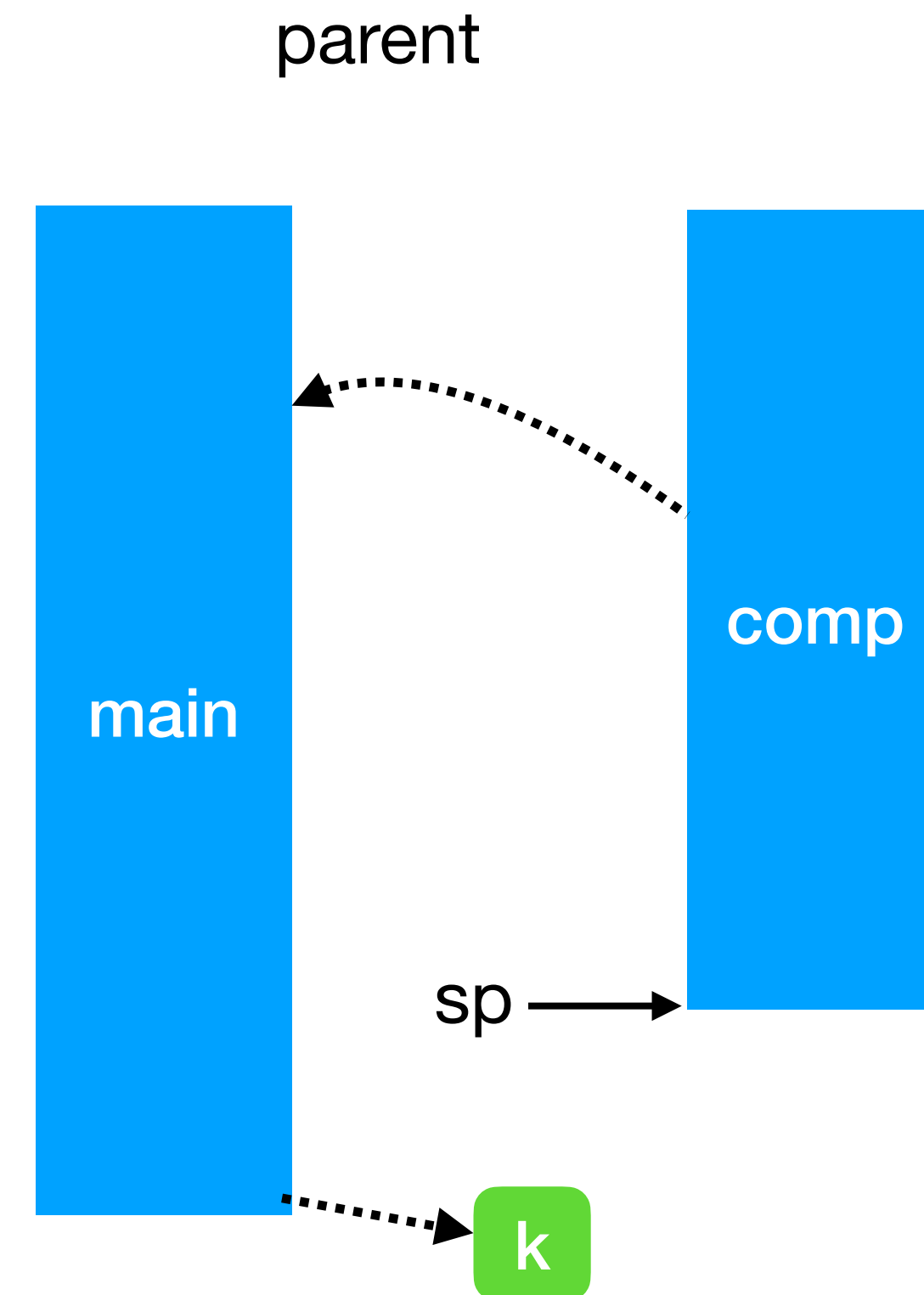
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0 1 2



Stepping through the example

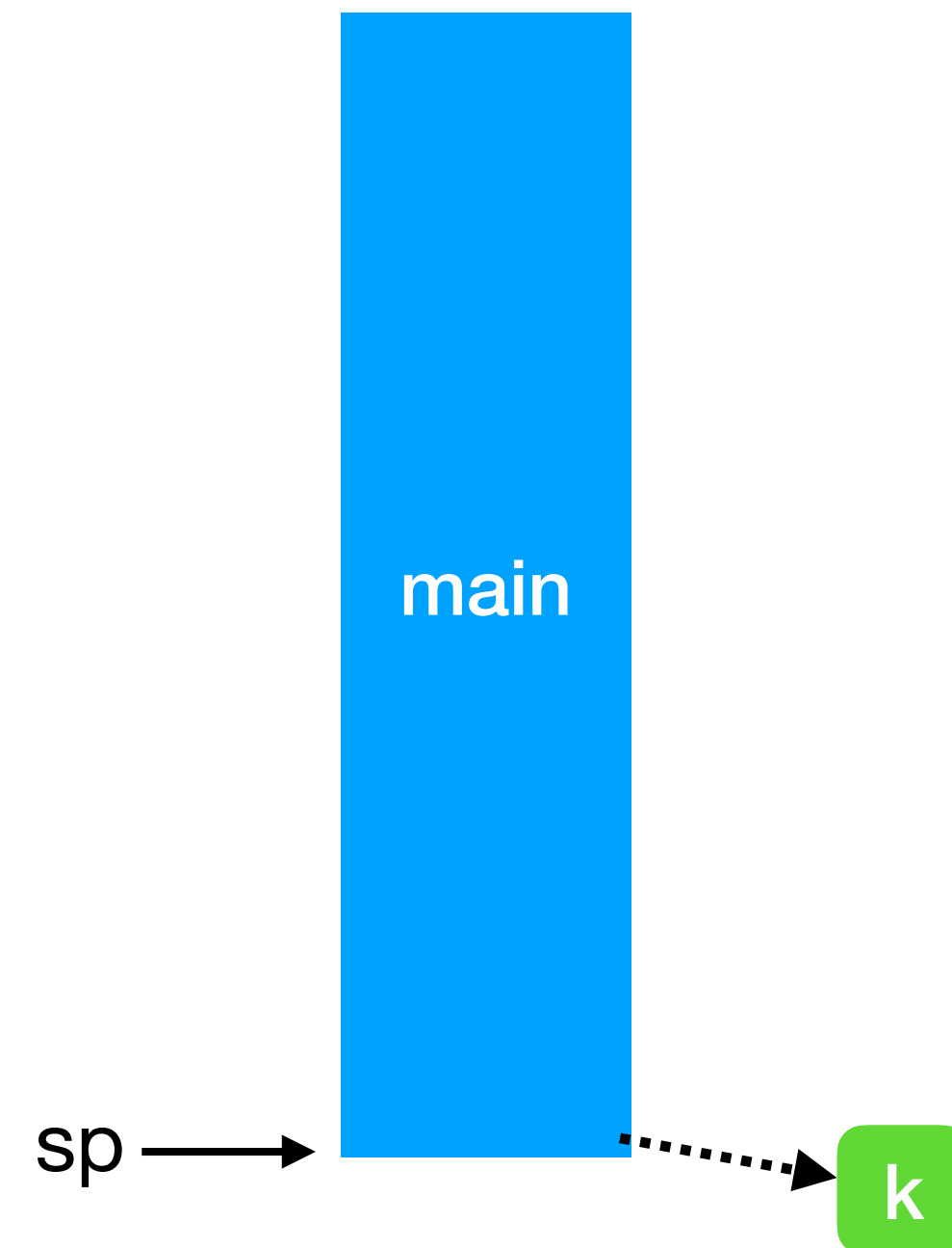
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pc →

0 1 2 3



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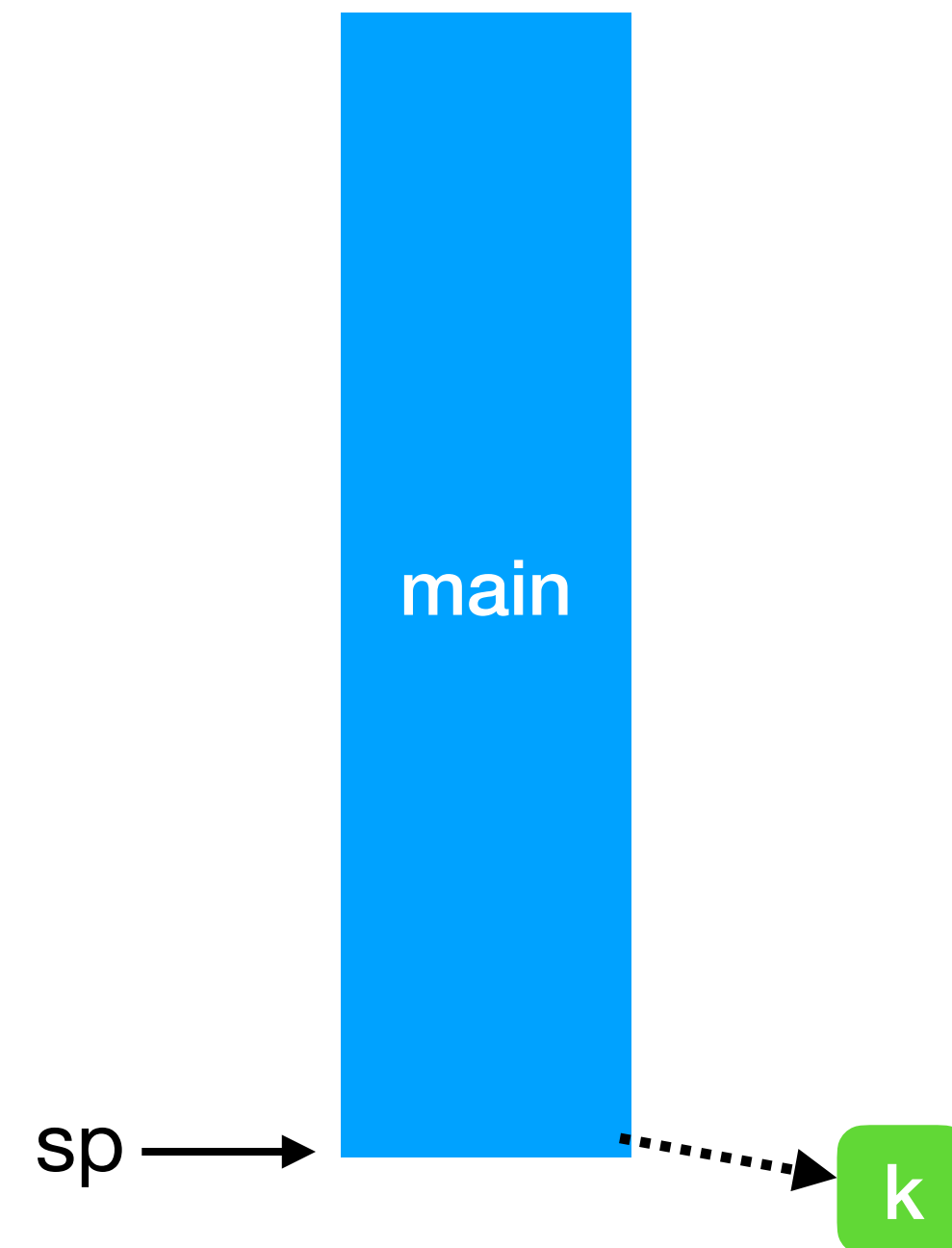
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Lightweight threading

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type _ eff += Fork   : (unit -> unit) -> unit eff  
           | Yield : unit eff
```

Lightweight threading

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              | Yield : unit eff

let run main =
  ... (* assume queue of continuations *)
  let run_next () =
    match dequeue () with
    | Some k -> continue k ()
    | None -> ()
  in
  let rec spawn f =
    match f () with
    | () -> run_next () (* value case *)
    | effect Yield, k -> enqueue k; run_next ()
    | effect (Fork f), k -> enqueue k; spawn f
  in
  spawn main
```

Effect Handler {

Lightweight threading

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let fork f = perform (Fork f)
let yield () = perform Yield
```

Effect Handler {

Lightweight threading

```
let main () =  
  fork (fun _ ->  
    print_endline "1.a";  
    yield ();  
    print_endline "1.b");  
  fork (fun _ ->  
    print_endline "2.a";  
    yield ();  
    print_endline "2.b")  
;;  
run main
```

Lightweight threading

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```
1.a  
2.a  
1.b  
2.b
```

Lightweight threading

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run main
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1.a
2.a
1.b
2.b

User-code need not be
aware of effects

Lightweight threading

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run main
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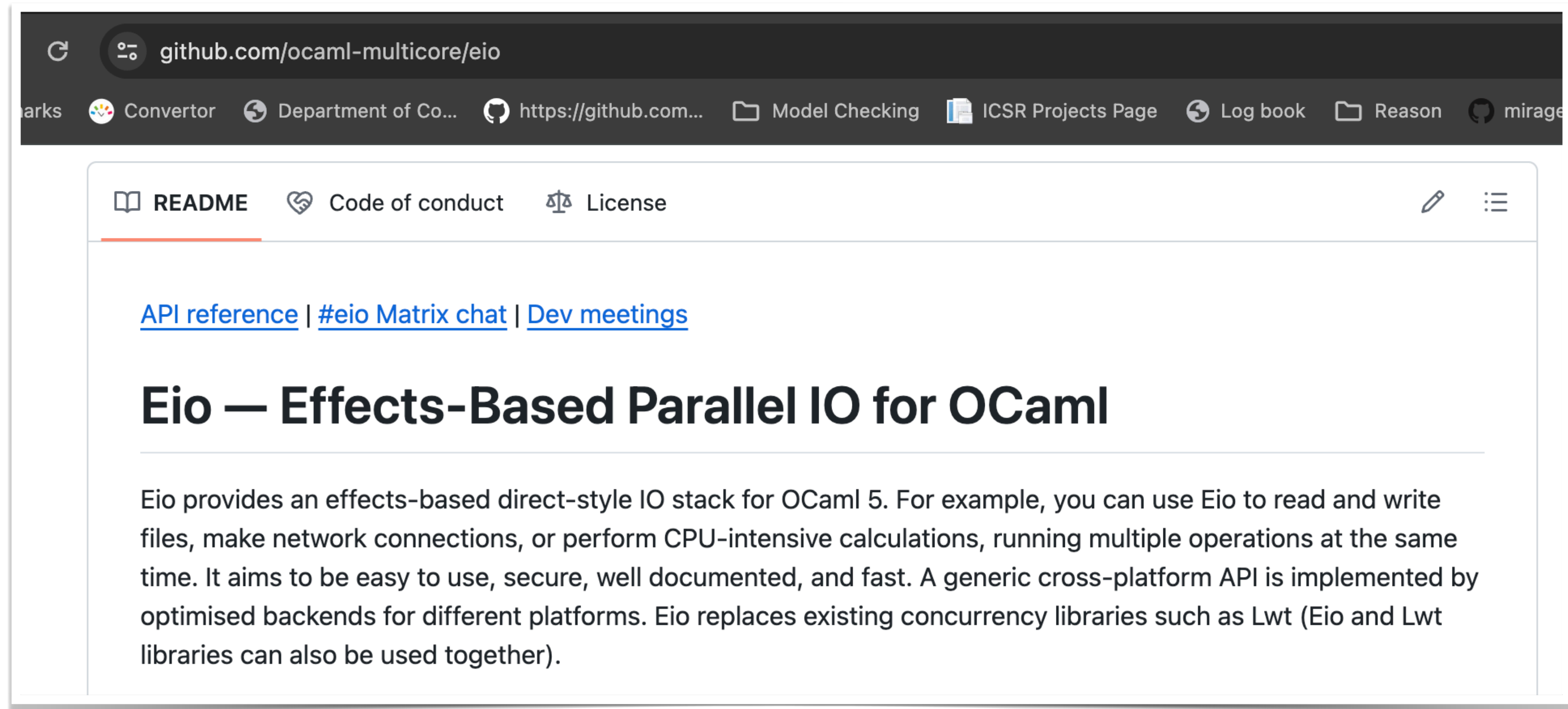
Ability to specialise scheduler
unlike GHC Haskell / Go

1.a
2.a
1.b
2.b

User-code need not be
aware of effects

Industrial-strength concurrency

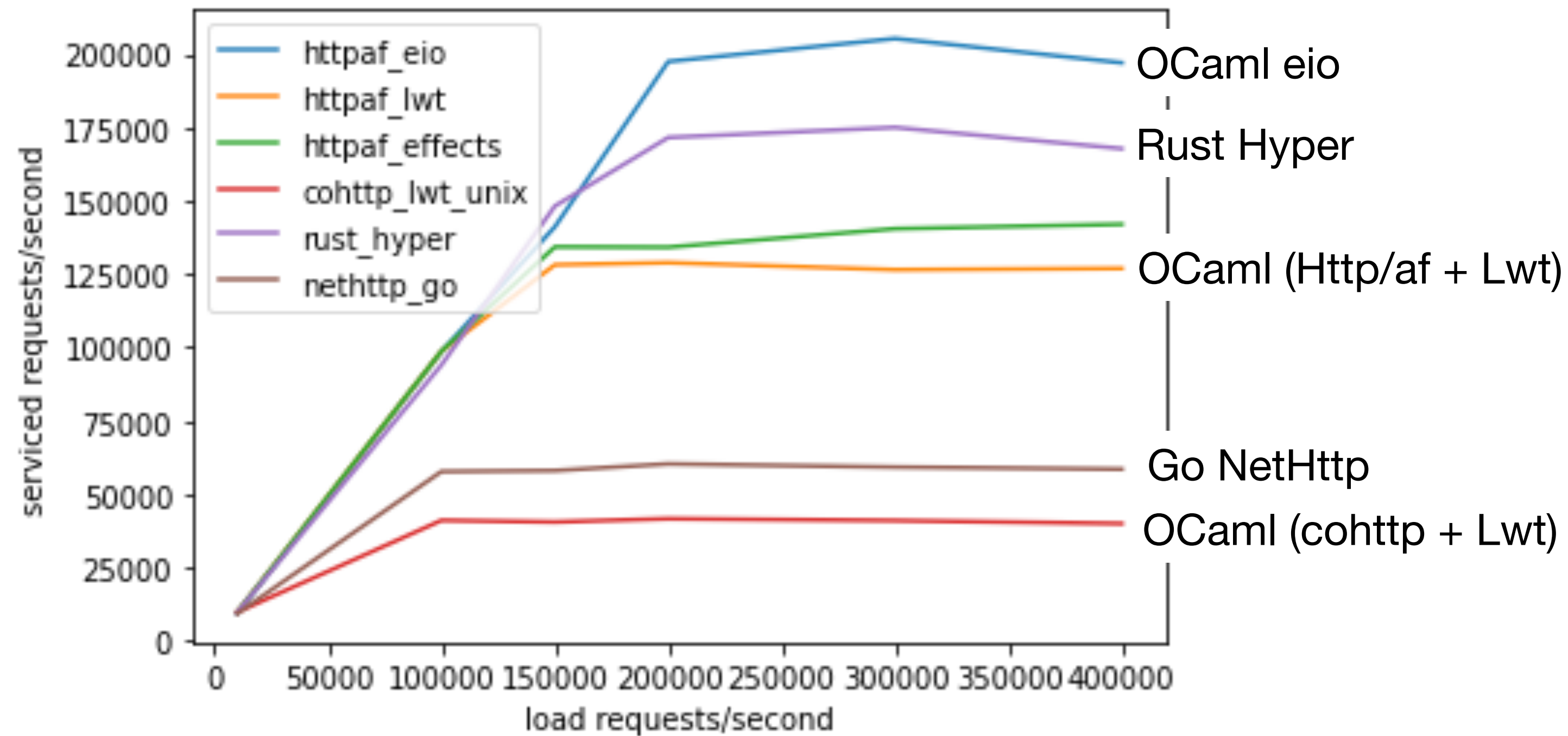
- **eio**: effects-based direct-style I/O
 - ✦ Multiple backends — epoll, select, ***io_uring*** (*new async io in Linux kernel*)



<https://github.com/ocaml-multicore/eio>

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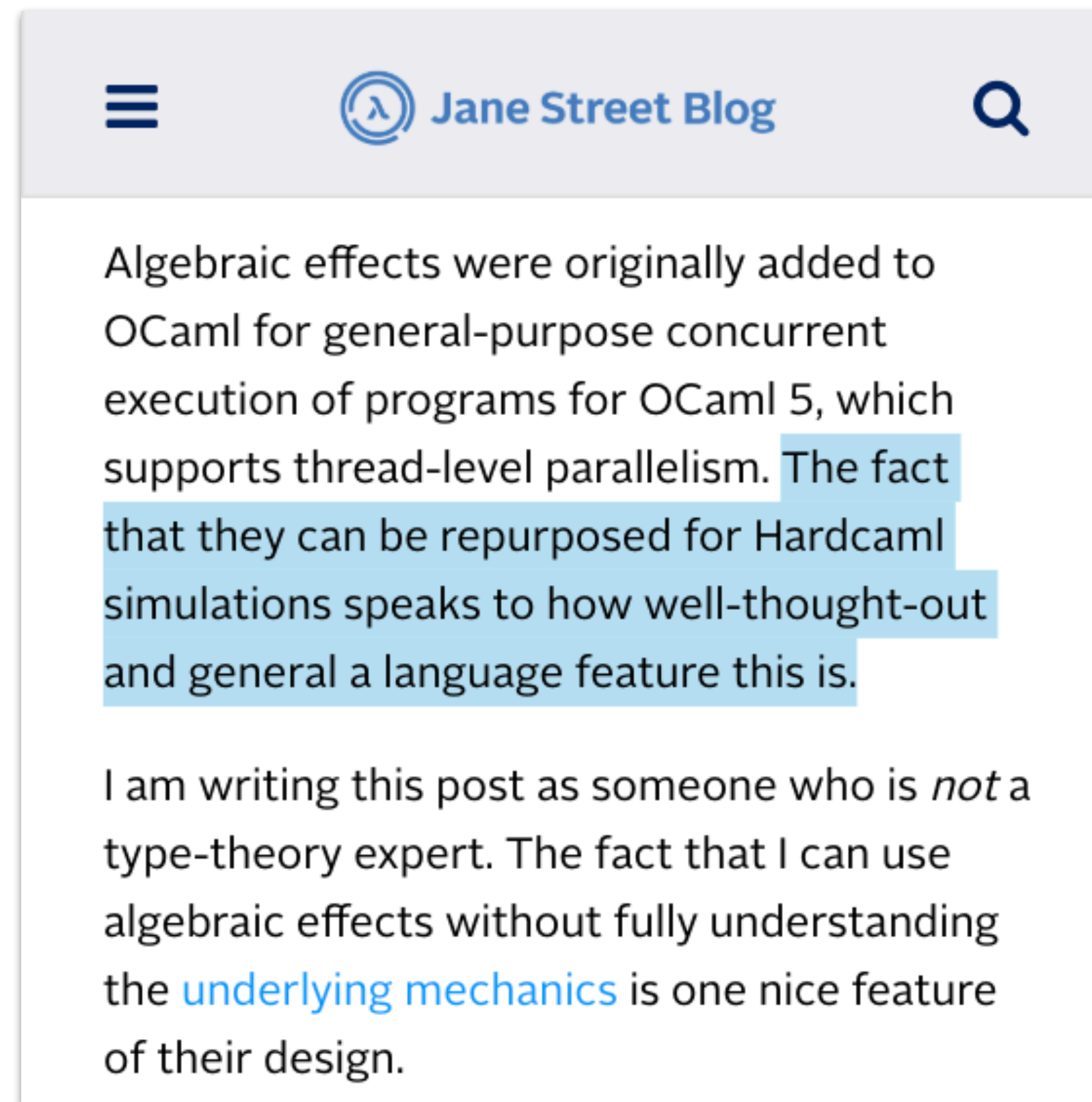


100 open connections, 60 seconds w/ io_uring

<https://github.com/ocaml-multicore/eio>

Unexpected uses

- Hardware simulations for HardCaml



<https://blog.janestreet.com/fun-with-algebraic-effects-hardcaml/>

Further reading

Control structures in programming languages: from goto to algebraic effects

Xavier Leroy

This book is a journey through the design space and history of programming languages from the perspective of control structures: the language mechanisms that enable programs to control their execution flows. Starting with the “goto” jumps of early programming languages and the emergence of structured programming in the 1960s, the book explores advanced control structures for imperative languages such as generators and coroutines, then develops alternate views of control in functional languages, first as continuations and their control operators, then as algebraic effects and effect handlers. Blending history, code examples, and theory, the book offers an original, comparative perspective on programming languages, as well as an extensive introduction to algebraic effects and other contemporary research topics in P.L.

Publication history

To be published by Cambridge University Press.

Book preview

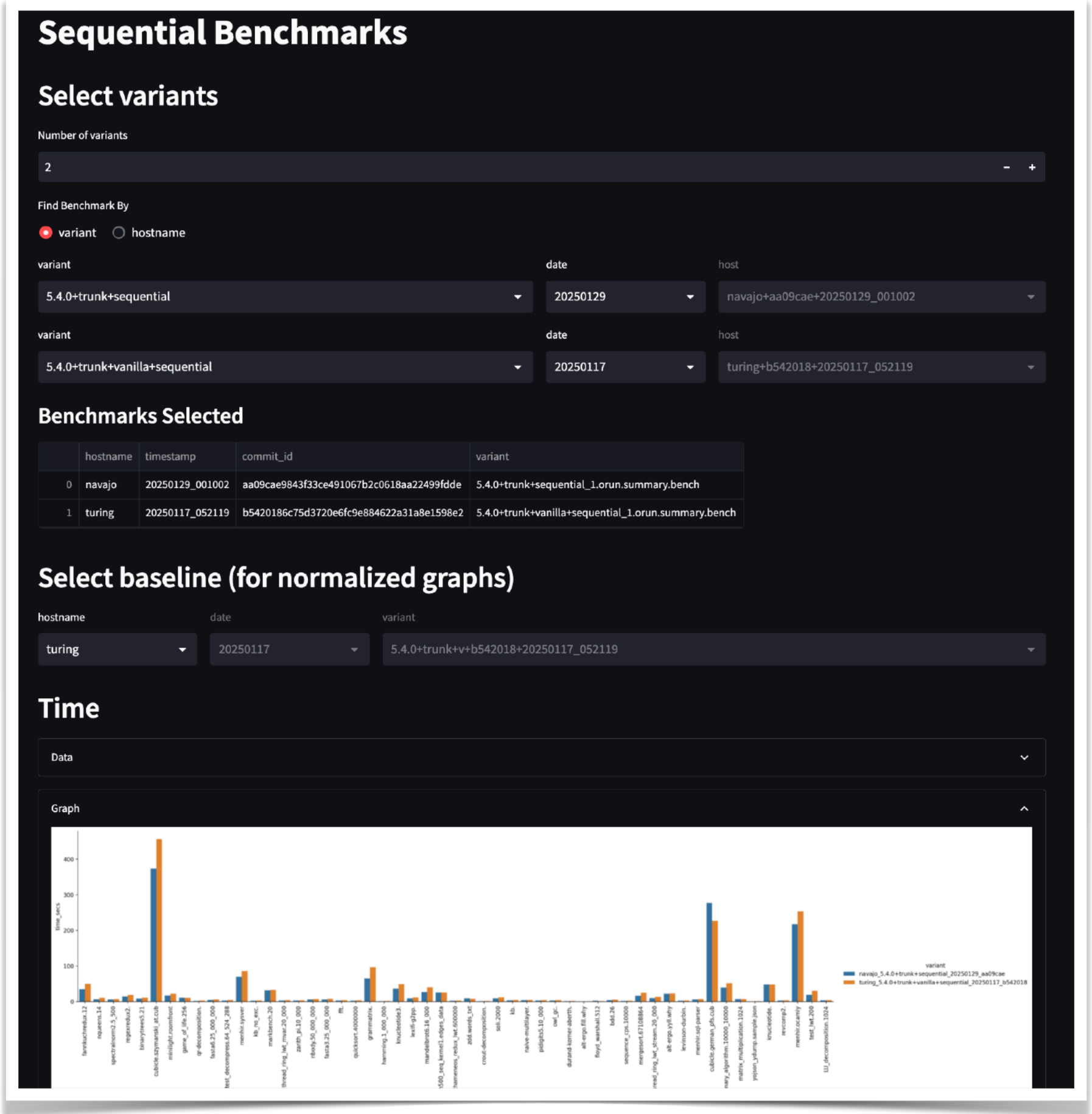
This is an HTML preview of the book, generated with [Hevea](#). License: [CC-BY-NC-ND 4.0](#).

- [Table of contents](#)
- [Introduction](#)

<https://xavierleroy.org/control-structures/>

Building confidence — Benchmarking

- *Rigorous*, *continuous* benchmarking on *real-world programs*
- sandmark.tarides.com — Benchmark suite, Infra and runners



Building confidence — CI for package universe

- *Can the new compiler build the existing universe?*
 - Build the OPAM universe of packages against *upstream* and *multicore* compilers

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| | 4.14 | 5.0+alpha-repo | number of revdeps |
|-------------------------|------|----------------|-------------------|
| 0install.2.18 | ☑ | ☒ | 1 |
| BetterErrors.0.0.1 | ☑ | ☒ | 7 |
| TCSLib.0.3 | ☑ | ☒ | 1 |
| absolute.0.1 | ☑ | ☒ | 0 |
| acgtk.1.5.3 | ☑ | ☒ | 0 |
| advi.2.0.0 | ☑ | ☒ | 0 |
| aez.0.3 | ☑ | ☒ | 0 |
| ahrocksdb.0.2.2 | ☒ | ☒ | 0 |
| aio.0.0.3 | ☑ | ☒ | 0 |
| alt-ergo-free.2.2.0 | ☑ | ☒ | 7 |
| amqp-client-async.2.2.2 | ☑ | ☒ | 0 |
| amqp-client-lwt.2.2.2 | ☑ | ☒ | 0 |
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Building confidence — CI for package universe

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You can contribute to the compiler development without hacking on the compiler

Release and Long Tail

- **Opened** — Dec 2021, **Merged** — Jan 2022
 -A few months of iteration to fix design issues and bugs....

The screenshot shows a GitHub pull request titled "Multicore OCaml #10831". It was merged by xavierleroy on Jan 10, 2022, merging 4,103 commits from the `ocaml-multicore:multicore-pr` branch into the `ocaml:trunk` branch. The interface includes statistics for 393 conversations, 250 commits, 0 checks, and 300+ files changed, with a net change of +22,955 lines and -14,062 lines. A comment by kayceesrk from Dec 21, 2021, describes the PR's goal: adding shared-memory parallelism through domains and direct-style concurrency through effect handlers, while maintaining backwards compatibility. A "For users" section points to a [multicore](#) link. A list of reviewers on the right includes abbysmal, gasche, sadiqj, avsm, xavierleroy, damiendoligez, and dra27.

Multicore OCaml #10831

Merged xavierleroy merged 4,103 commits into `ocaml:trunk` from `ocaml-multicore:multicore-pr` on Jan 10, 2022

Conversation 393 Commits 250 Checks 0 Files changed 300+ +22,955 -14,062

kayceesrk commented on Dec 21, 2021 • edited

This PR adds support for shared-memory parallelism through domains and direct-style concurrency through effect handlers (without syntactic support). It intends to have backwards compatibility in terms of language features, C API, and also the performance of single-threaded code.

For users

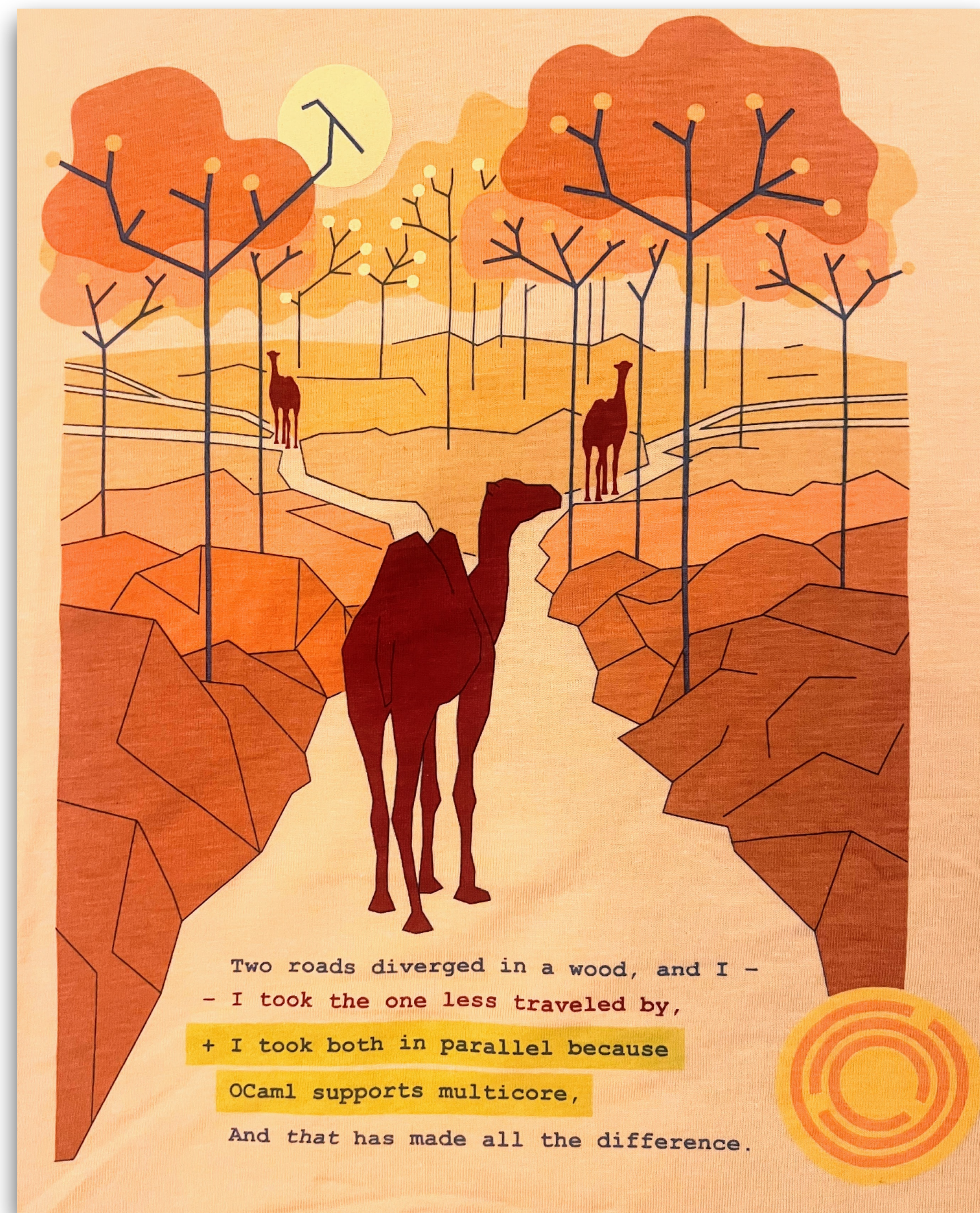
If you want to learn more about Multicore OCaml, please have a look at the [multicore](#)

Reviewers

- abbysmal
- gasche
- sadiqj
- avsm
- xavierleroy
- damiendoligez
- dra27

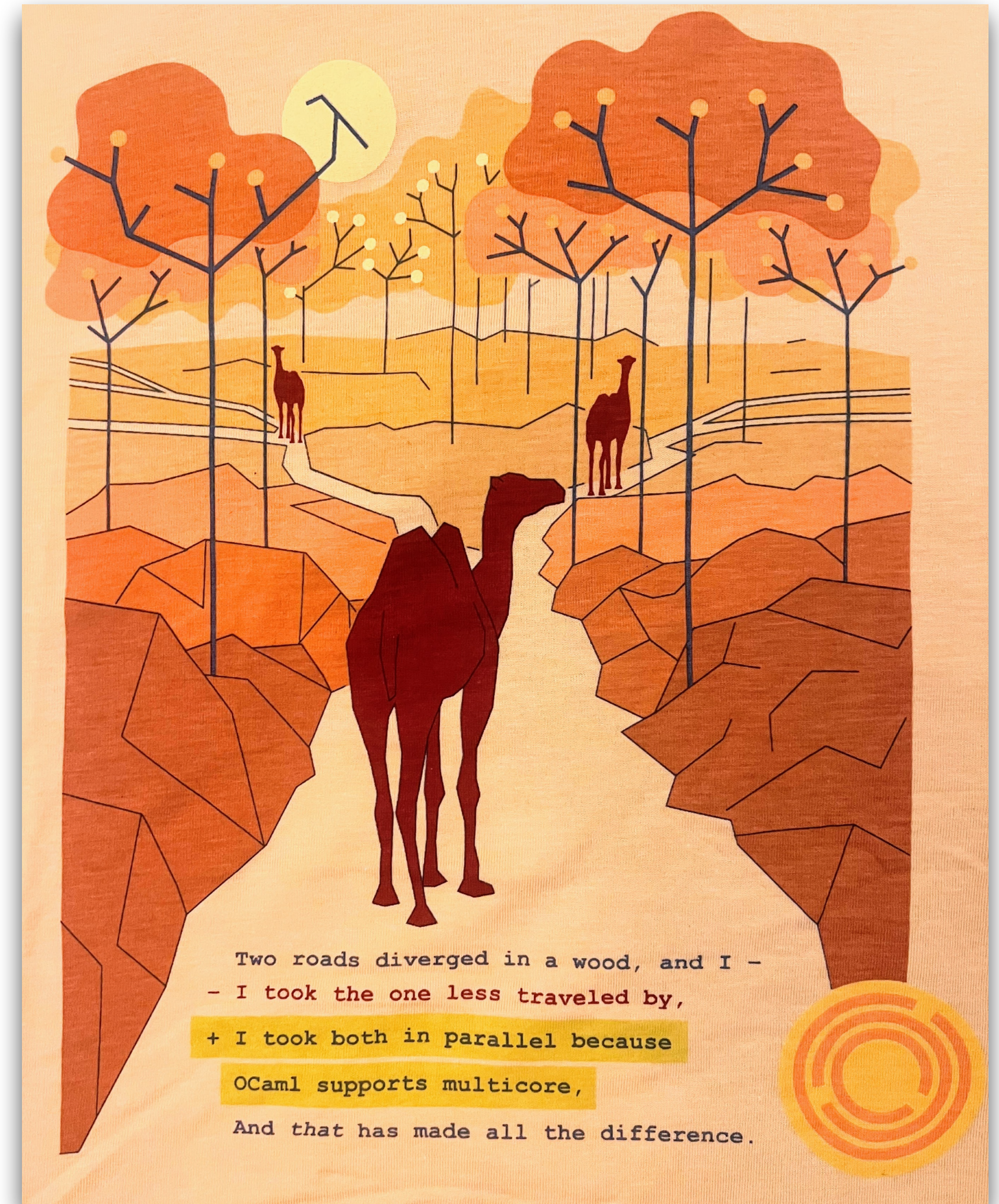
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- **Long tail** of adding missing features, bug fixes and performance improvements
 - 5.1 — Sep 2023
 - 5.2 — May 2024
 - 5.3 — Jan 2025
 - 5.4 — Sep 2025



What's next for OCaml?

- **OxCaml** — Bridging the performance and safety gap between OCaml and Rust
 - *Data-race-free parallelism* through *modes*
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<https://oxcaml.org>

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- But different in other ways...
 - In production at Jane Street
 - Valuable user-feedback-oriented design



<https://oxcaml.org>

CS6868 Concurrent Programming

CS6868 Spring 2026 [Schedule](#) [Assignments](#) [Resources](#) [GitHub](#)




Photo © [Madras Inherited](#)

CS6868: Concurrent Programming

Course Overview

This course explores the fundamentals of concurrent and parallel programming with a focus on shared-memory multiprocessor systems. You'll learn to design and implement correct, efficient concurrent programs while understanding the theoretical foundations and practical challenges of concurrency and parallelism.

Key Topics:

- Principles of concurrent programming
- Mutual exclusion and synchronization
- Concurrent data structures
- Lock-free and wait-free algorithms
- Memory models and consistency
- Parallel programming patterns
- Effect handlers
- Nested parallelism, Asynchronous I/O
- Practical implementations using OCaml 5's multicore features
- Safe parallel programming with OxCaml

The course uses **OCaml 5** with native support for parallelism via [domains](#) and concurrency via [effect handlers](#), providing hands-on experience with modern concurrent programming techniques.

https://kcsrk.info/cs6868_s26/



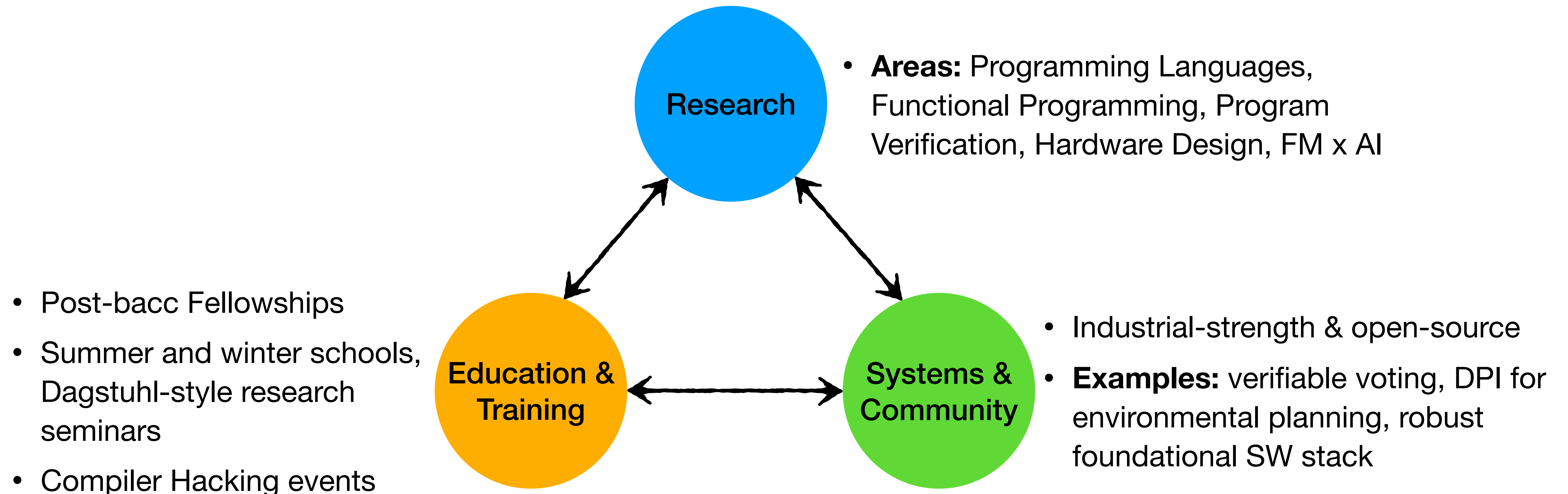
FP Launchpad

*Build research and educational capacity for crafting **efficient, reliable**
and trustworthy software with mathematical guardrails.*



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OCaml

An industrial-strength functional programming language with an emphasis on expressiveness and safety

[Install](#) [About OCaml](#)

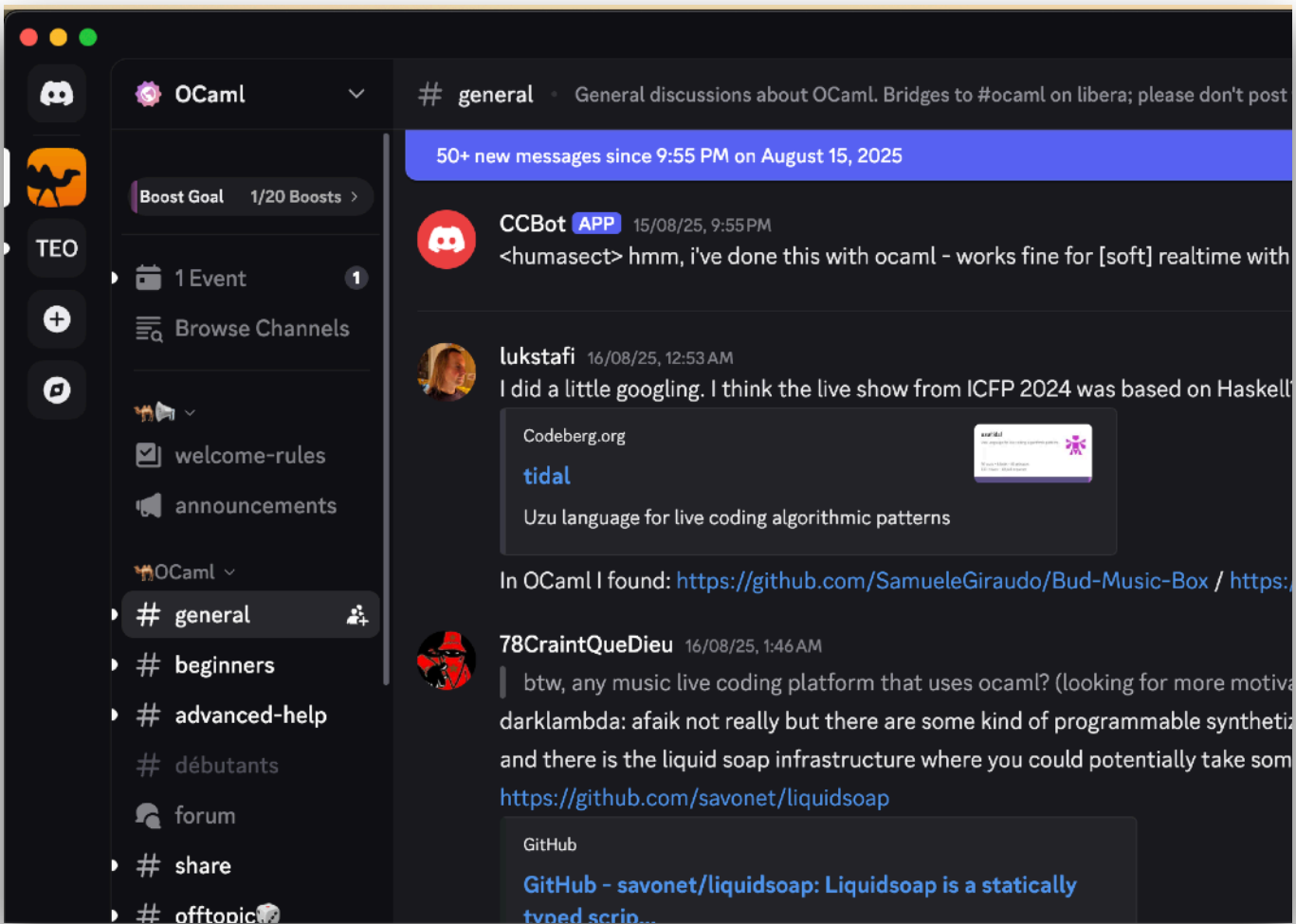
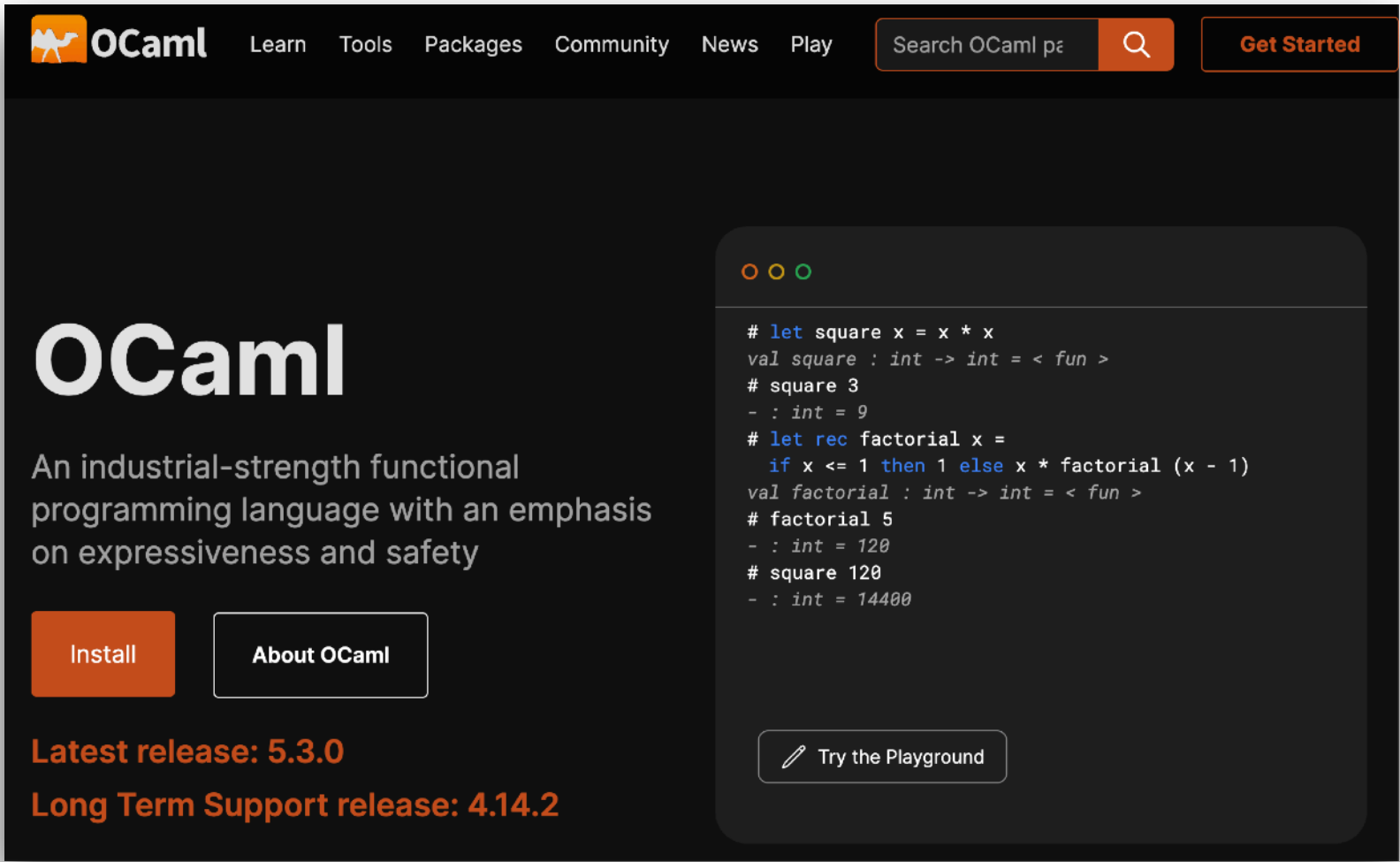
Latest release: 5.3.0
Long Term Support release: 4.14.2

```
# let square x = x * x
val square : int -> int = < fun >
# square 3
- : int = 9
# let rec factorial x =
  if x <= 1 then 1 else x * factorial (x - 1)
val factorial : int -> int = < fun >
# factorial 5
- : int = 120
# square 120
- : int = 14400
```

[Try the Playground](#)

Get Involved!

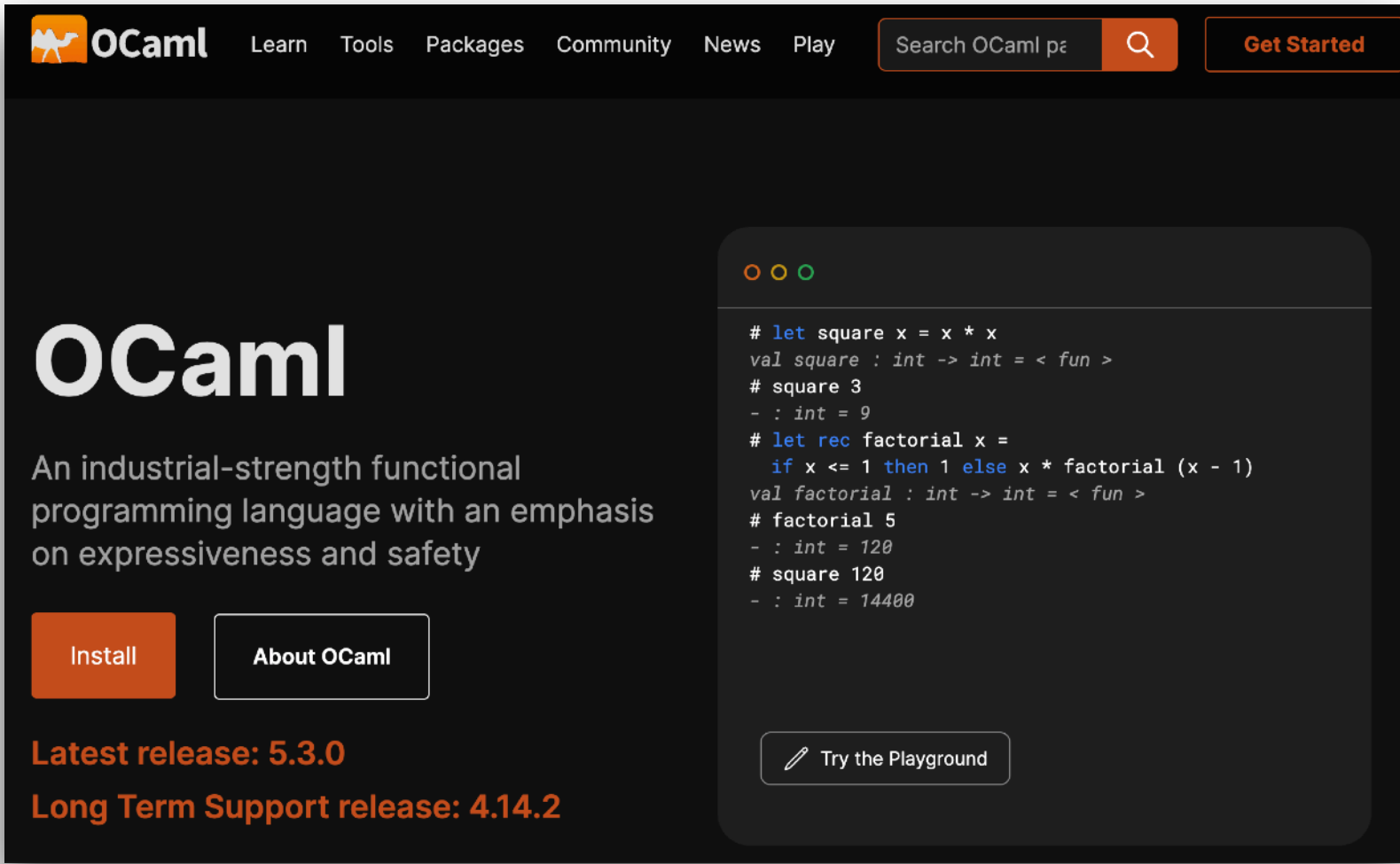
ocaml.org



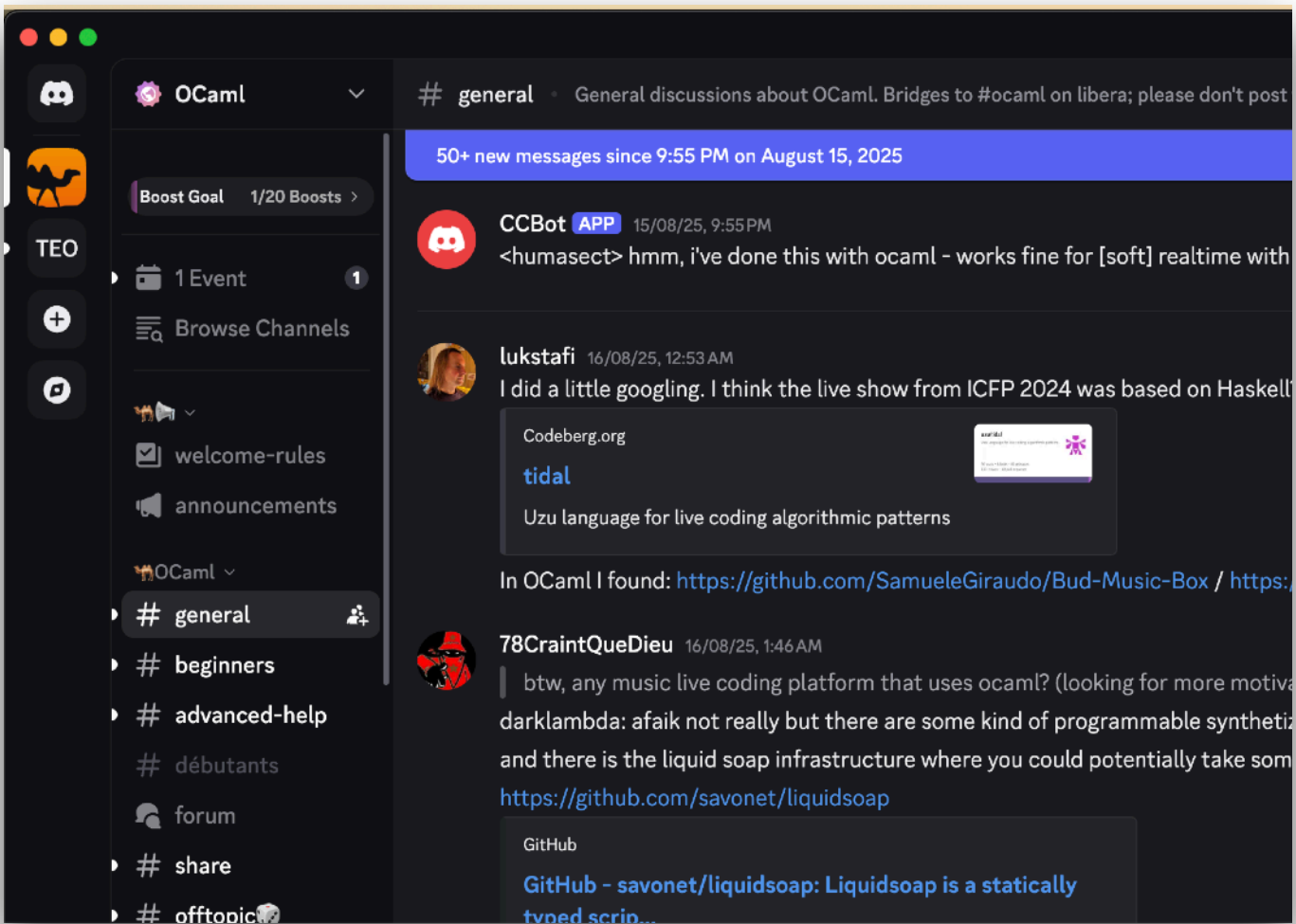
OCaml
Discord

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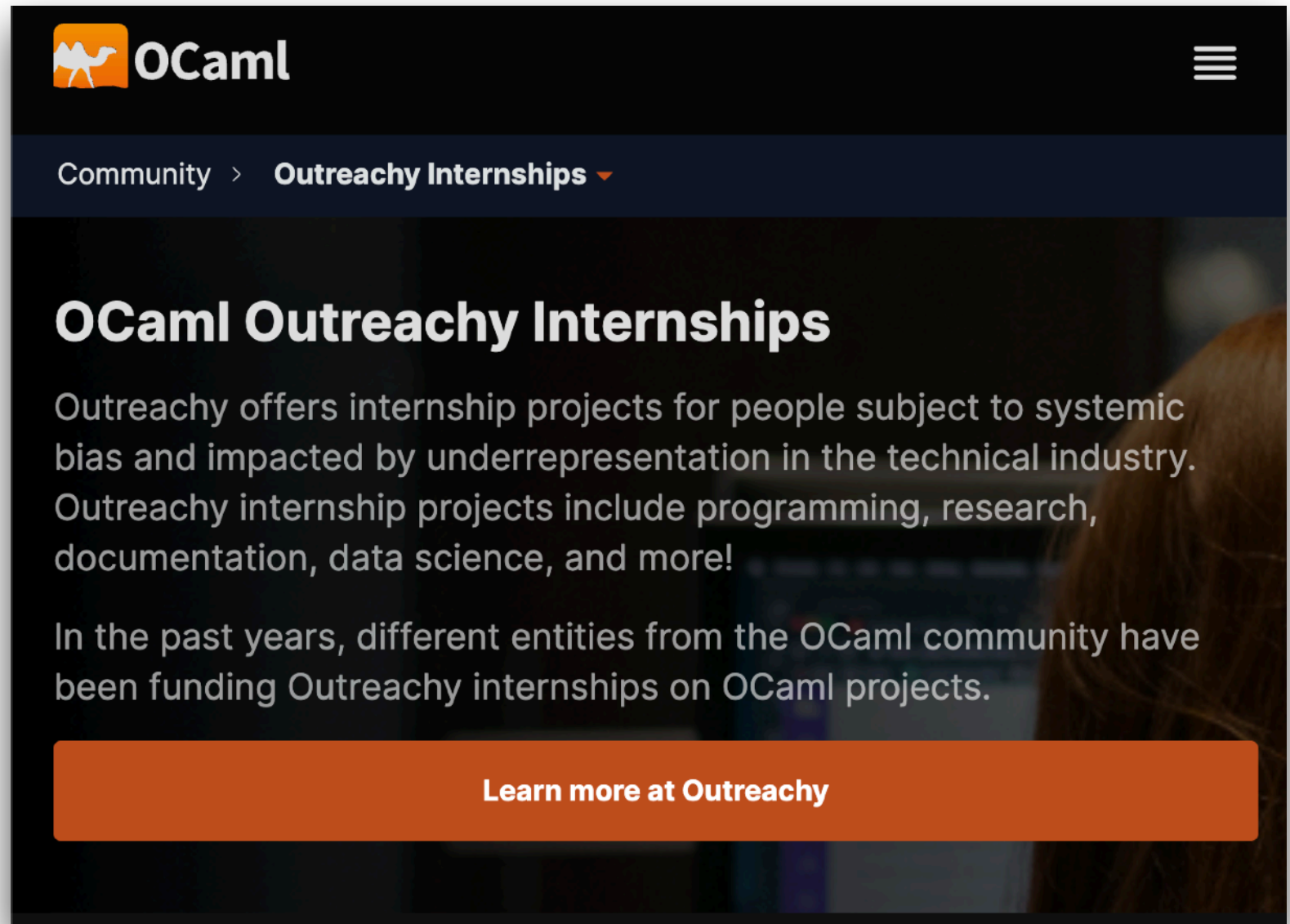
ocaml.org



OCaml
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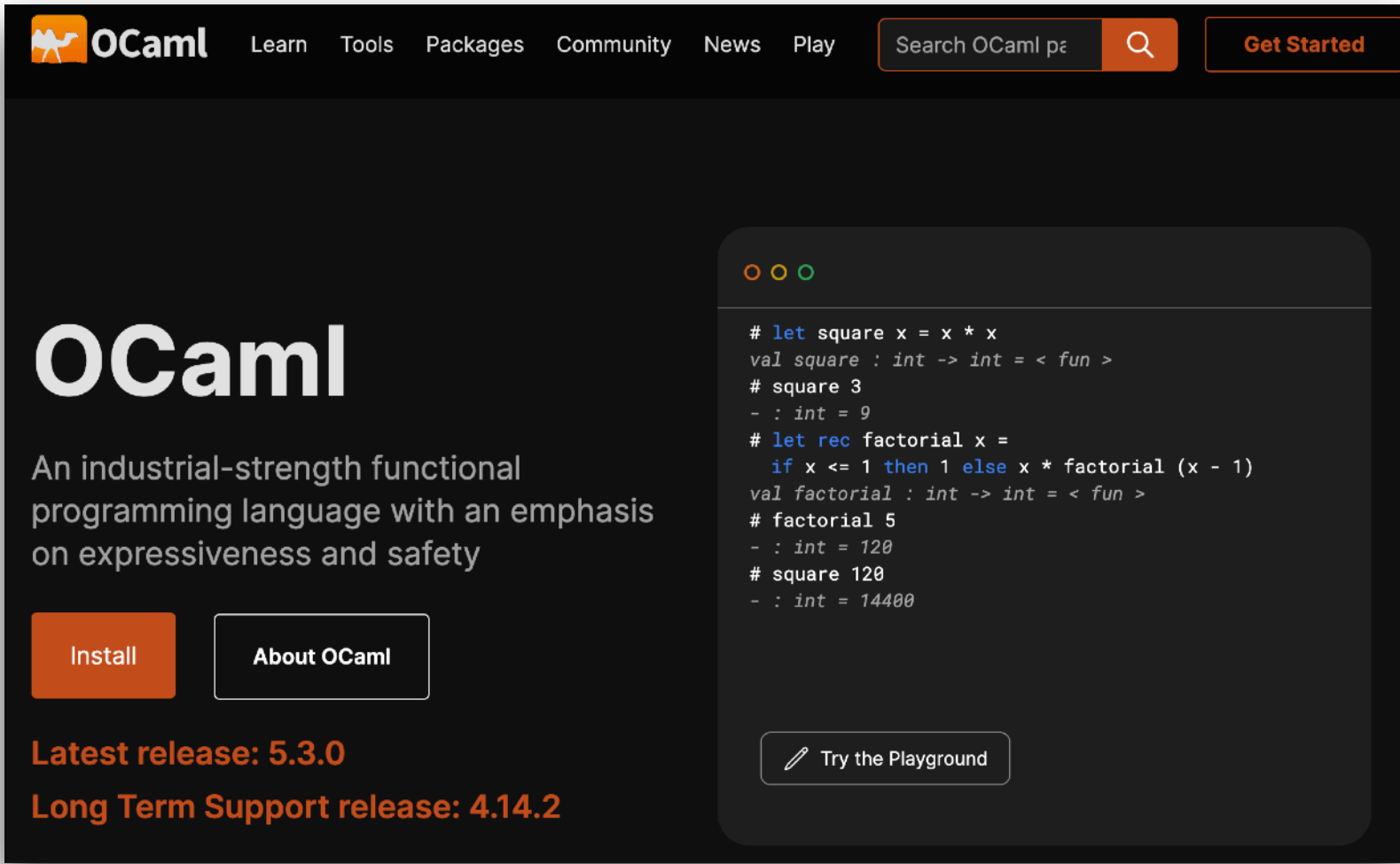


ocaml.org/outreachy

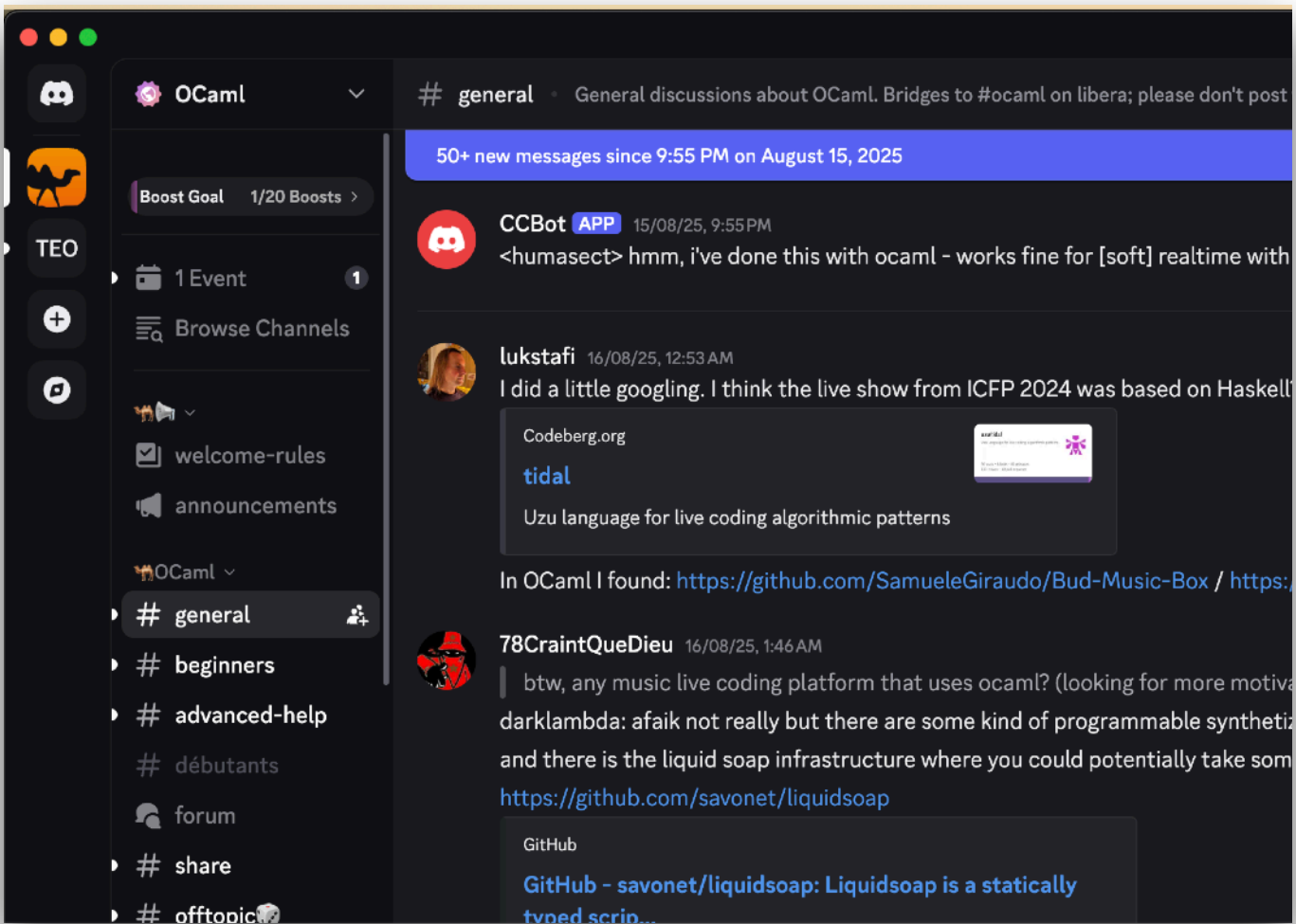


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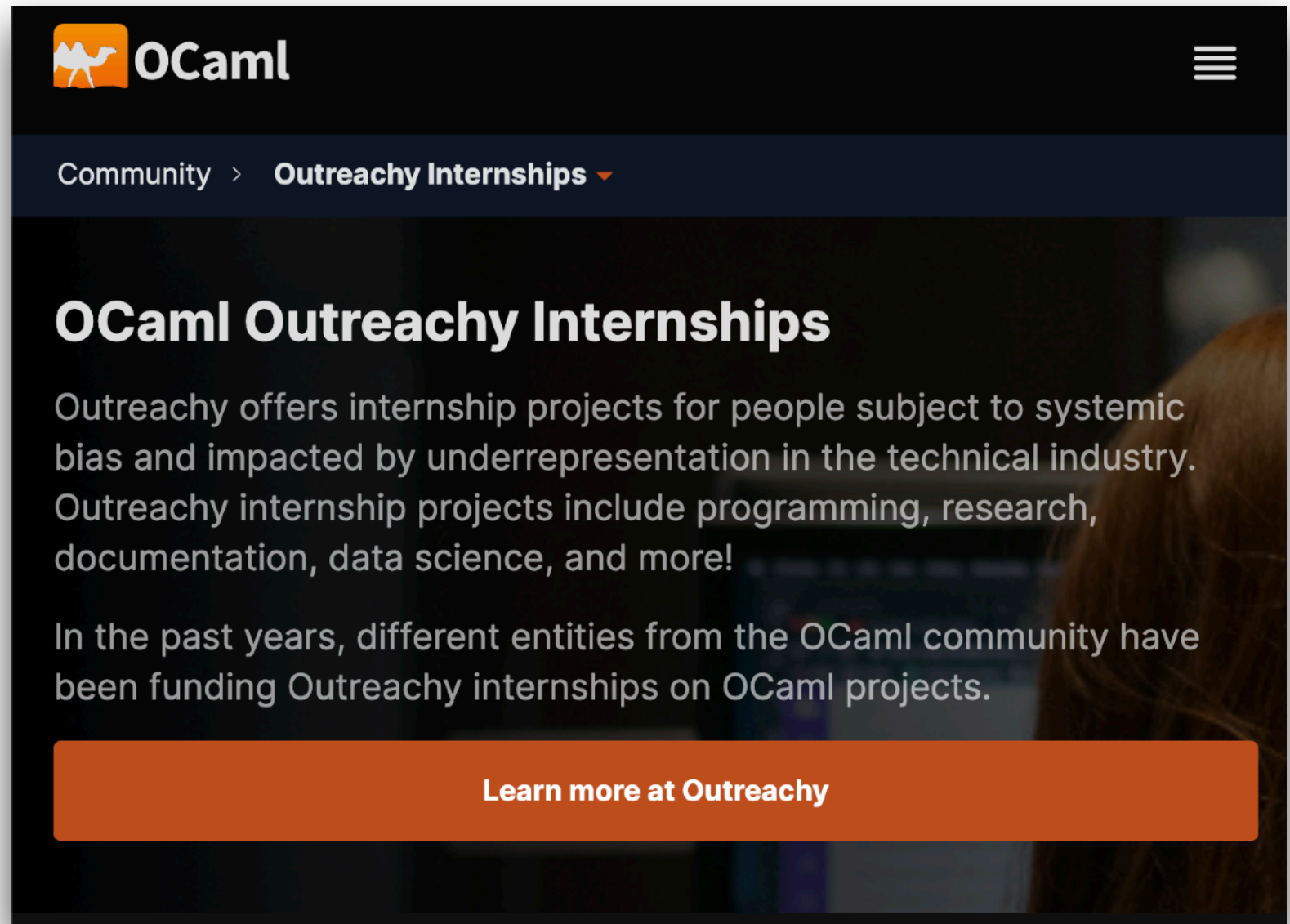
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github.com/ocaml

