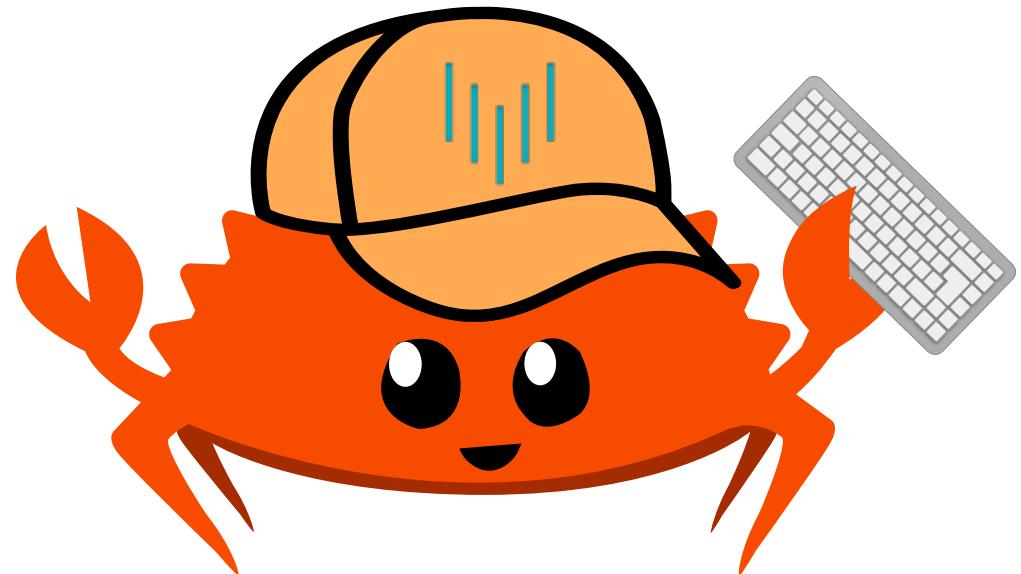


# Programování v Rustu (PvR)



AR 2024/2025

Kuba Beránek



[github.com/kobzol](https://github.com/kobzol)

# Schedule

- Lecture: 1x per week

# Schedule

- Lecture: 1x per week
  - Discussions :)

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  - Discussions :)
  - Seminar: 1x per week

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  - Interactive coding, assignments

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- Lecture: 1x per week
  - Discussions :)
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  - Open-source contributions?

# Points



# Points

- Assignments
  - 1x per week, ~10 in total
  - Wednesday - Monday (?)
  - **60 points** in total

# Points

- Assignments
  - 1x per week, ~10 in total
  - Wednesday - Monday (?)
  - **60 points** in total
- Project
  - 1 (max. 2?) projects, assigned in ~October
  - Non-trivial application in Rust
  - **40 points**
  - Oral examination at the end of the semester

# What is PvR about?



# What is PvR about?

- Rust (the language)

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- Rust (ideas, concepts)

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- Transferrable to other technologies!

# What is PvR about?

- Rust (the language)
- Rust (ideas, concepts)
  - Transferrable to other technologies!
  - System programming, networking

Your experience and knowledge?

# Rust

A language empowering everyone  
to build reliable and efficient software.

# Rust in a nutshell



# Rust in a nutshell

- **Correctness and robustness**

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  - Memory safety

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  - Compiled to native code



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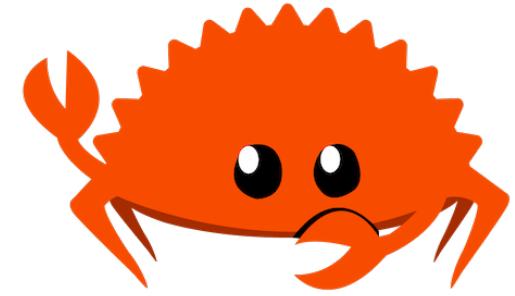
# Rust in a nutshell

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- **Productivity**
  - Integrated package manager, great tooling



# Rust in a nutshell

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  - Memory safety
  - Static + strong typing
  - Explicit
  - Avoids surprises and UB
- **Performance**
  - Compiled to native code
  - No GC, minimal runtime
- **Productivity**
  - Integrated package manager, great tooling
  - OOP + FP paradigms



```
fn main() {
    println!("Hello PvR!");
}
```



# History of Rust



2006

Started as a personal project  
by Graydon Hoare (@Mozilla)



2006

Started as a personal project  
by Graydon Hoare (@Mozilla)

“

I think I named it after fungi...  
that is "over-engineered for survival".

Graydon Hoare ,”



# Project Servo

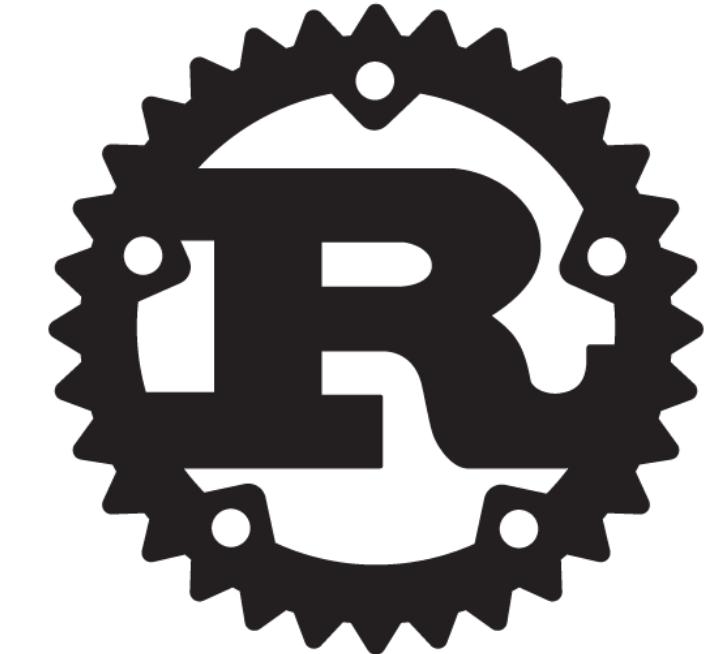
Technology from the past  
come to save the future  
from itself

Mozilla Annual Summit, July 2010  
[<graydon@mozilla.com>](mailto:graydon@mozilla.com)

2006

2010

# Project Servo



Technology from the past  
come to save the future  
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Mozilla Annual Summit, July 2010  
[<graydon@mozilla.com>](mailto:graydon@mozilla.com)



Rust 1.0 released

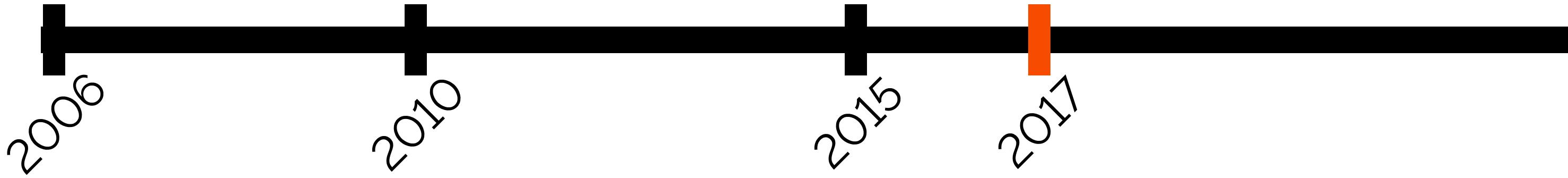




Rust 1.0 released



Strong backwards-compatibility promise



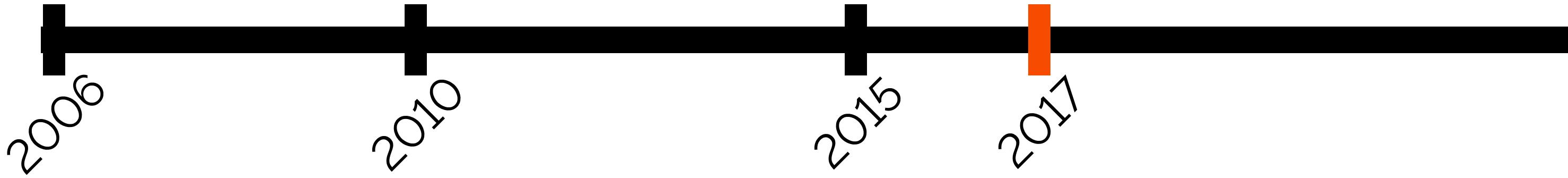
# Inside a super fast CSS engine: Quantum CSS (aka Stylo)



By [Lin Clark](#)

Posted on August 22, 2017 in [Code Cartoons](#), [CSS](#), and [Featured Article](#)





Posted by u/[deleted] 7 years ago

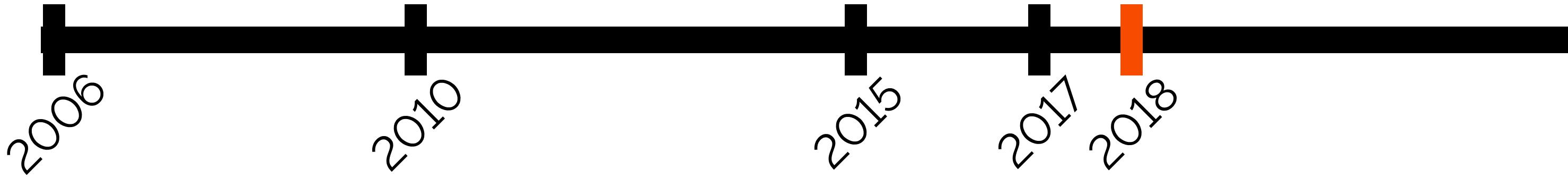
283

**Visual Studio Code's new ripgrep-powered search  
has been released!**



[code.visualstudio.com/update...](http://code.visualstudio.com/update...) ↗



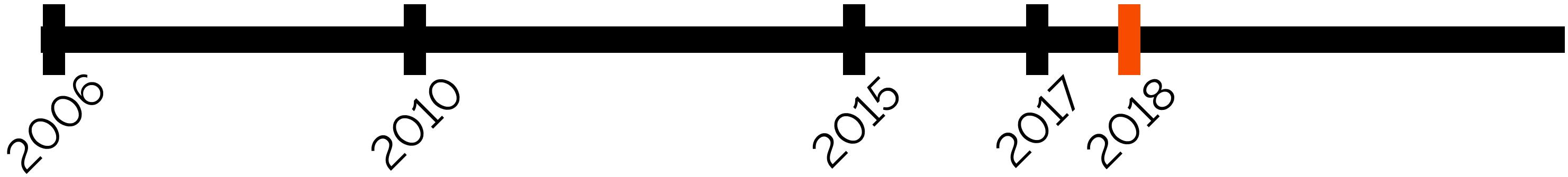


# Announcing Rust 1.31 and Rust 2018

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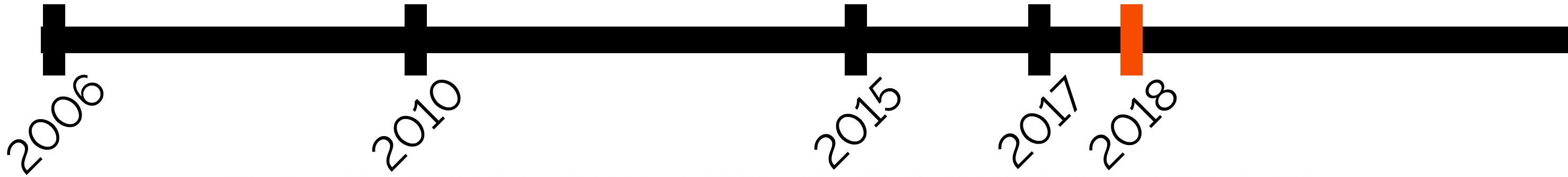
Dec. 6, 2018 · The Rust Core Team



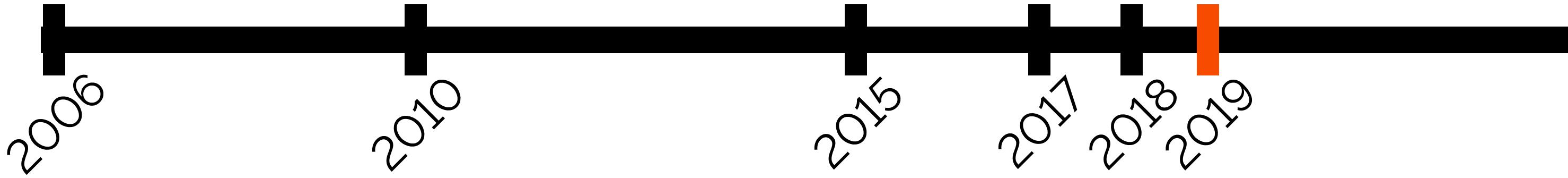


How Mozilla's new language dramatically improved our server-side performance

*Like building state-of-the-art web apps? Come work at Figma!*



Metric	Old server	→	New server	Improvement
Peak average per-worker memory usage	4.2gb	→	1.1gb	3.8x smaller
Peak average per-machine CPU usage	24%	→	4%	6x smaller
Peak average file serve time	2s	→	0.2s	10x faster
Peak worst-case save time	82s	→	5s	16.4x faster

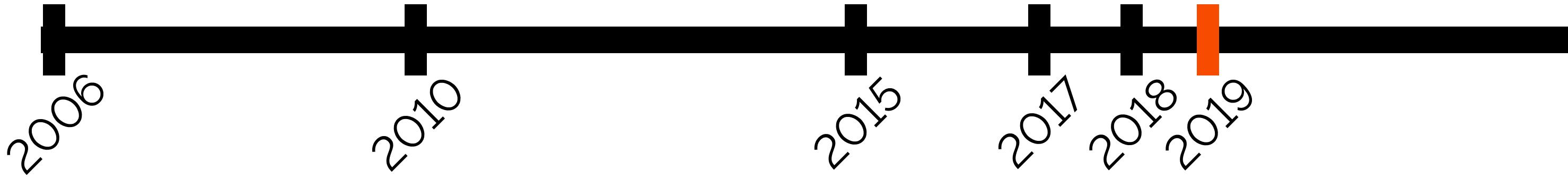


Rust Case Study:

# Community makes Rust an easy choice for npm

---

The npm Registry uses Rust for its CPU-bound bottlenecks



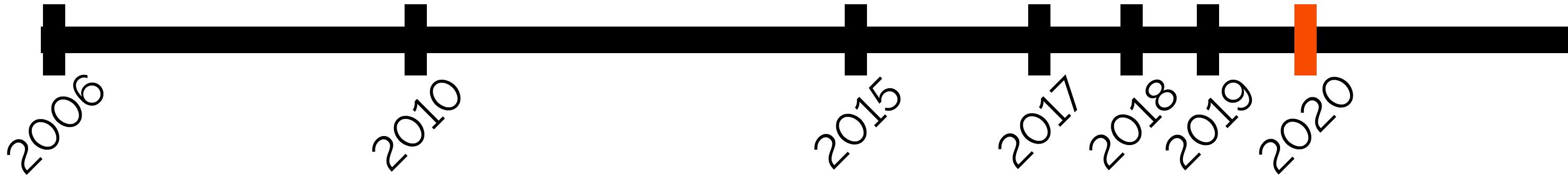
## Rust Case Study:

“

The good news for the npm team is that the **Rust** service has been **running** for more than one year **in production without a single alert**. This is in stark contrast to the usual experience of deploying a Node.js service...

npm ”

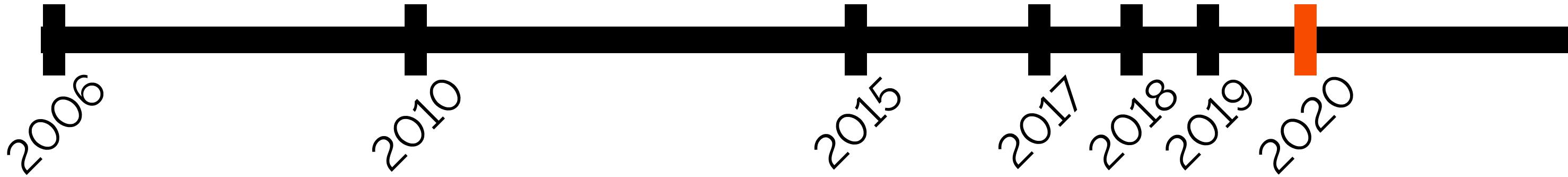
THE NPM REGISTRY USES RUST FOR ITS CPU-BOUND BOTTLENECKS



# Rewriting the heart of our sync engine

// By Sujay Jayakar • Mar 09, 2020



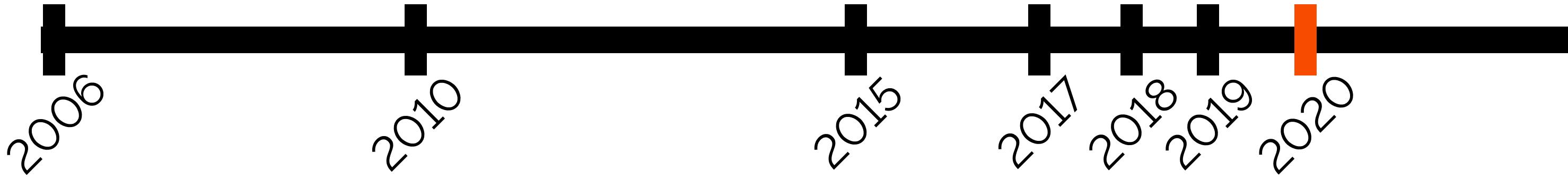


“

**..betting on Rust was one of the best decisions we made.**  
More than performance, its ergonomics and focus on correctness  
has helped us tame sync's complexity.

Dropbox ,”





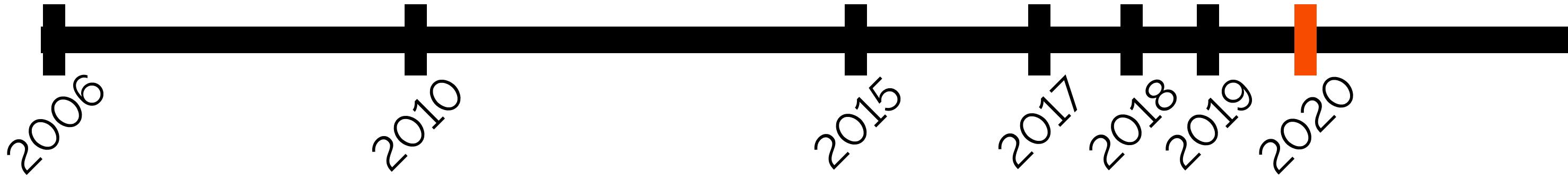
ENGINEERING & DEVELOPERS

# WHY DISCORD IS SWITCHING FROM GO TO RUST



Jesse Howarth  
February 4, 2020

Rust is becoming a first class language in a variety of domains. At Discord, we've seen success with Rust on the client side and server side. For example, we use it on the client side for our video encoding pipeline for Go Live and on the server side for [Elixir NIFs](#).



#### ENGINEERING & DEVELOPERS

“

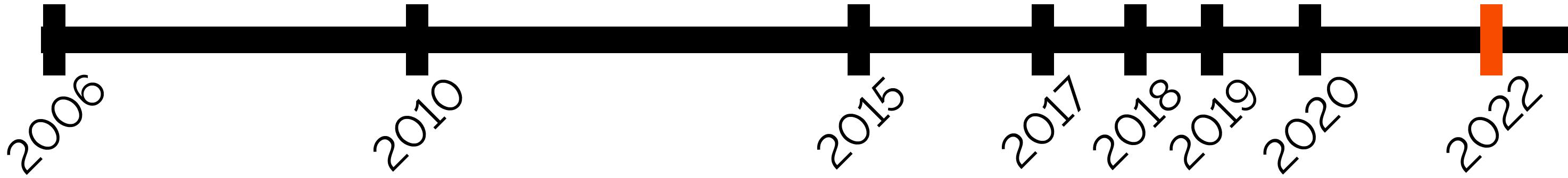
Even with just basic optimization, Rust was able to outperform the hyper hand-tuned Go version.

**...we were able to beat Go on every single performance metric.**

Discord ,”

February 4, 2020

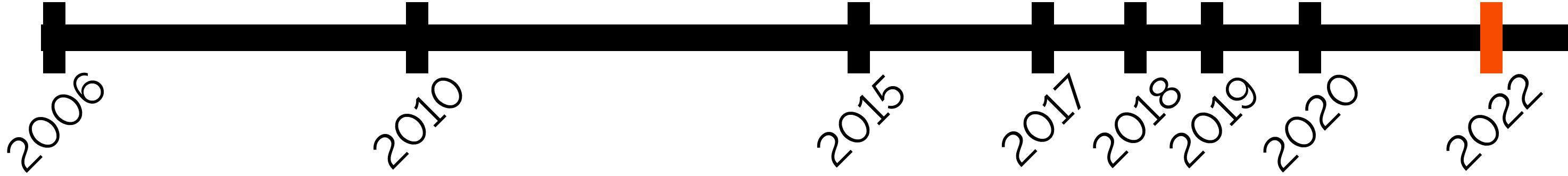
encoding pipeline for Go Live and on the server side for [Elixir NIFs](#).



# Meta Adds Rust to Its Portfolio of Internally-Supported Languages

Wednesday, social media giant Meta announced that it is now officially using Rust as a server side programming language.

Jul 28th, 2022 12:05pm by [Jessica Wachtel](#)

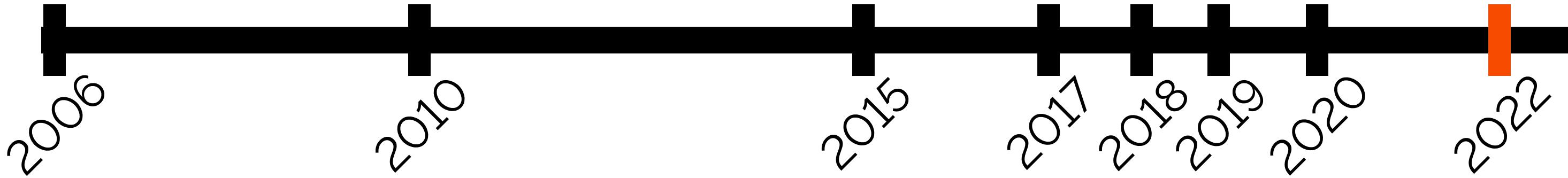


Meta “  
Inte  
...we're committing to Rust long-term ;  
and welcome early adopters.  
Wednesday  
Jul 28th, 2022

Meta ,”

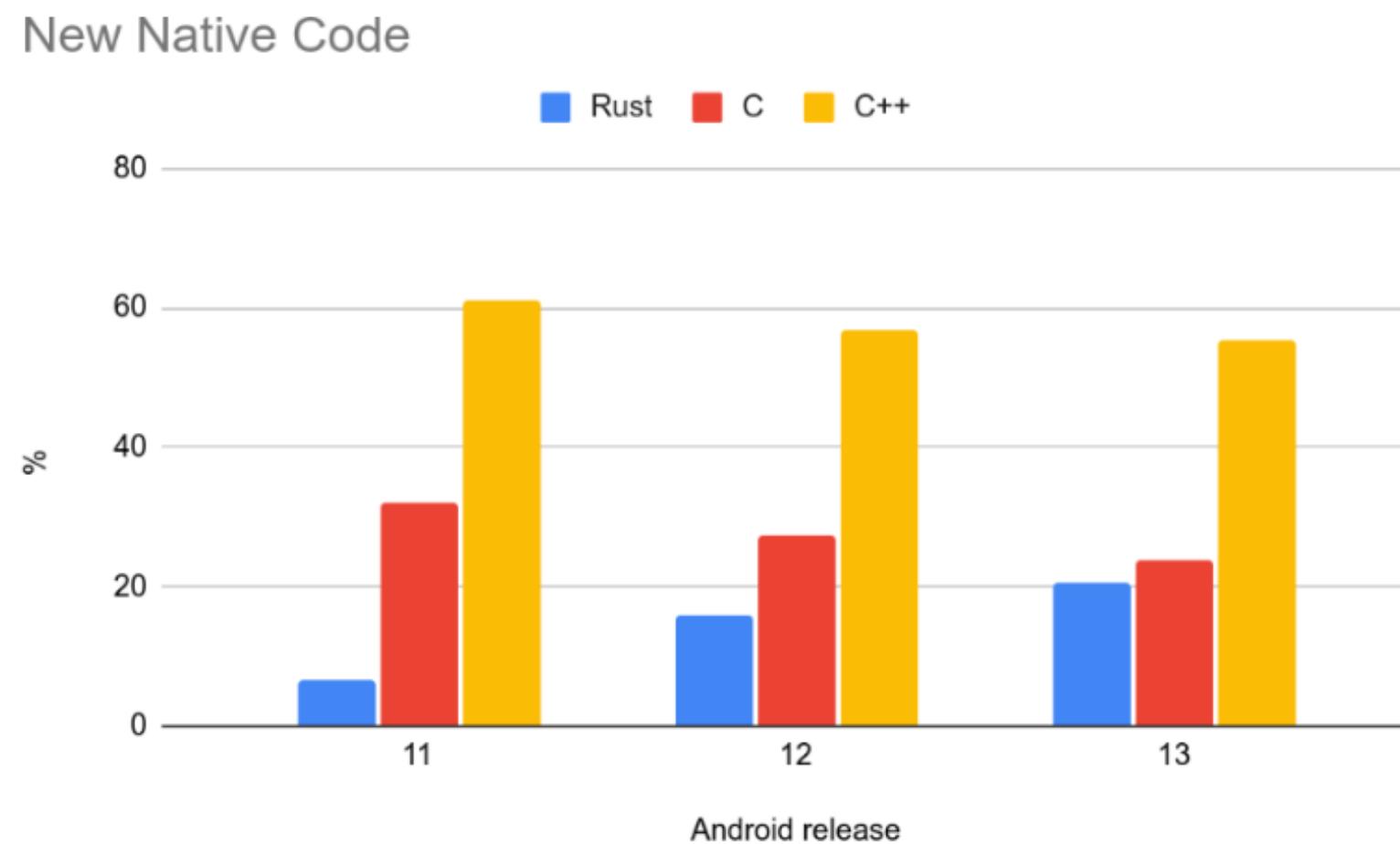
server side



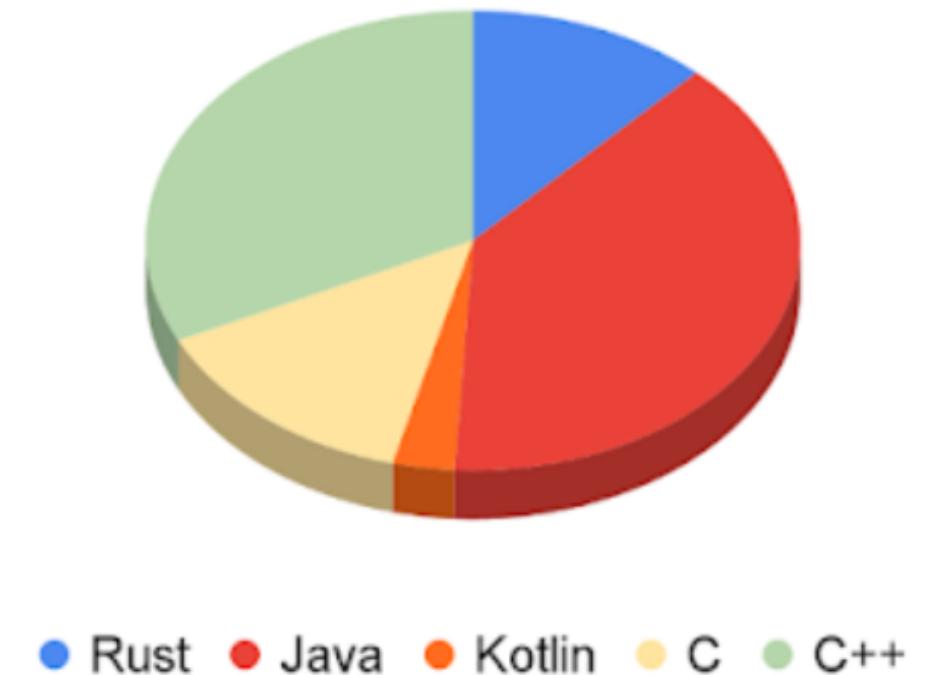


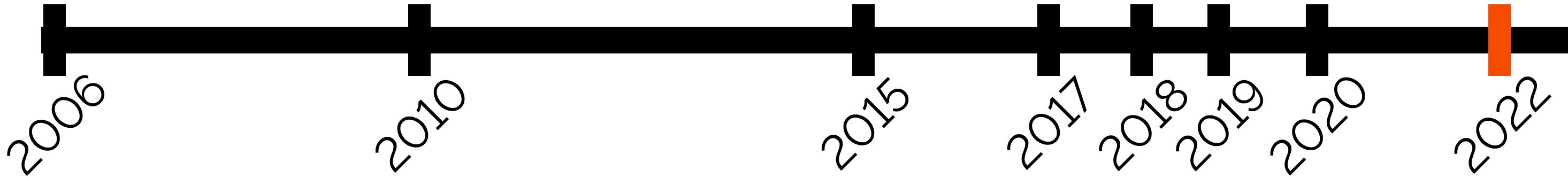
## Memory Safe Languages in Android 13

December 1, 2022



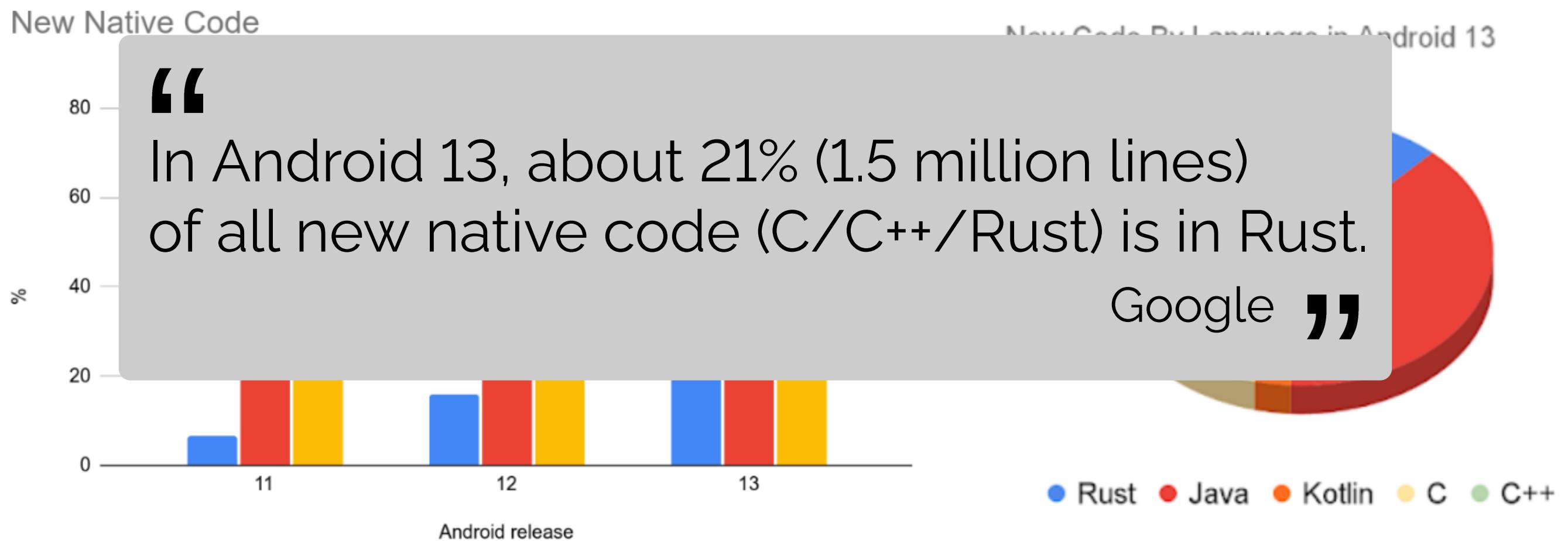
### New Code By Language in Android 13

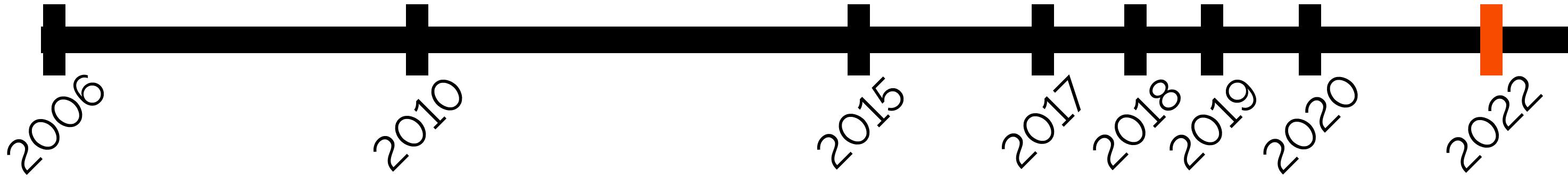




## Memory Safe Languages in Android 13

December 1, 2022

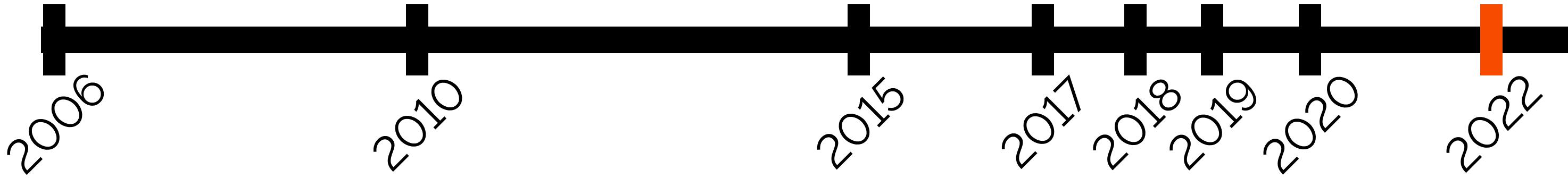




# Rust Programming Language To Land in Linux Kernel 6.1

By [Ian Evenden](#) published October 06, 2022

Linux will support the Rust programming language in its kernel from version 6.1.



# Rust Programming Language To Land in Linux Ker

By Ian Evenden published

Linux will support

from version 6.1.

“

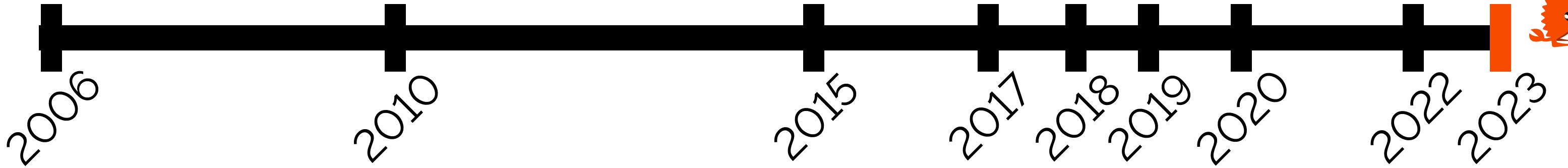
...on the whole, I don't hate it.

Linus Torvalds

”

age in its kernel





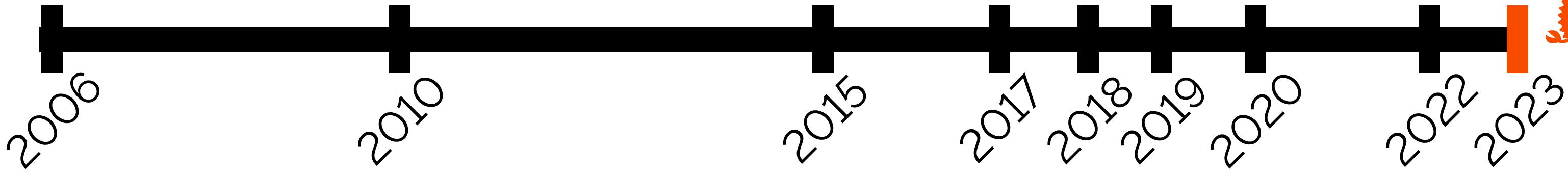
# GitHub built a new search engine for code 'from scratch' in Rust

GitHub built a new code-focused search engine in Rust because popular text search engines couldn't scale enough.



Written by **Liam Tung**, Contributing Writer

Feb. 9, 2023 at 3:24 a.m. PT



 **Mark Russinovich**  
@markrussinovich

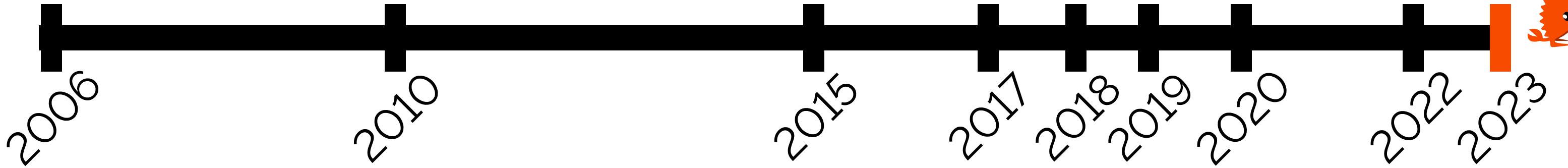
If you're on the Win11 Insider ring, you're getting the first taste of Rust in the Windows kernel!

```
C:\Windows\System32>dir win32k*
Volume in drive C has no label.
Volume Serial Number is E60B-9A9E

Directory of C:\Windows\System32

04/15/2023  09:50 PM           708,608 win32k.sys
04/15/2023  09:49 PM          3,424,256 win32kbase.sys
04/15/2023  09:49 PM          110,592 win32kbase_rs.sys
04/15/2023  09:50 PM          4,194,304 win32kfull.svs
04/15/2023  09:49 PM          40,960 win32kfull_rs.sys
04/15/2023  09:49 PM          69,632 win32krnl.sys
04/15/2023  09:49 PM          98,304 win32ksgd.sys
                           7 File(s)    8,646,656 bytes
                           0 Dir(s)  116,366,049,280 bytes free
```

\_rs = Rust!



Mark Russinovich  
@markrussinovich

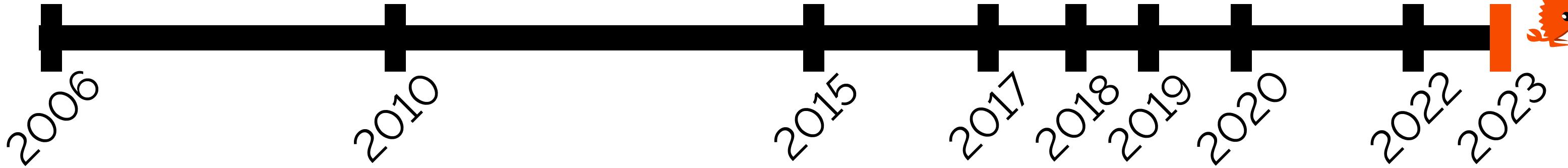
...

“

Speaking of languages, it's time to halt starting any new projects in C/C++ and **use Rust for those scenarios where a non-GC language is required**. For the sake of security and reliability, the industry should declare those languages as deprecated.

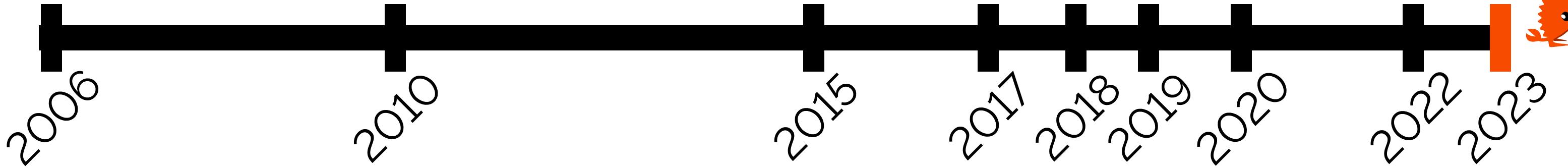
Mark Russinovich ,”

7 File(s) 8,646,656 bytes  
0 Dir(s) 116,366,049,280 bytes free



# Microsoft posts ‘early stages’ code for developing Windows drivers in Rust

By **Tim Anderson** - September 25, 2023



# Introducing the Azure Quantum Development Kit Preview

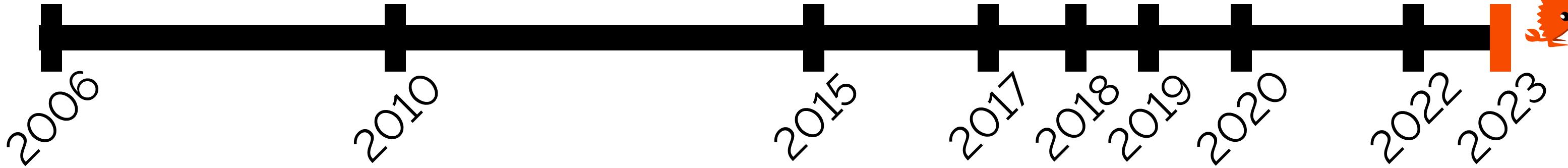


Bill Ticehurst

---

September 19th, 2023 | 6 | 7

*100x faster, 100x smaller, and it runs in the browser!*

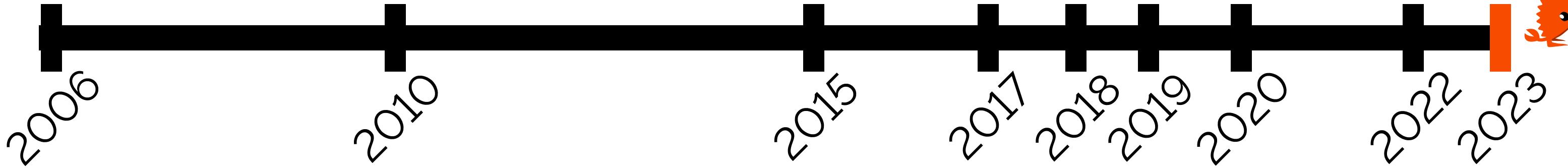


# Ferrocene Safety-Critical Rust Compiler Code Published

Written by [Michael Larabel](#) in [Programming](#) on 5 October 2023 at 05:15 PM EDT.

[35 Comments](#)

Ferrous Systems has made available open-source code for Ferrocene, their Rust compiler focused on safety-critical and mission-critical environments. The Ferrocene compiler is being made available under Apache 2.0 or MIT licensing.



Posted by u/Chadshinshin32 4 months ago

833

**2023 Stack Overflow Survey: Rust is  
the most admired programming  
language, making it the most loved  
language for 8 years in a row**



[survey.stackoverflow.co/2023/](https://survey.stackoverflow.co/2023/) ↗



# Rust development



# Rust development

- Fully open-source



# Rust development

- Fully open-source
- Governed by a set of teams (mostly volunteers)



# Rust development

- Fully open-source
- Governed by a set of teams (mostly volunteers)
- New releases every six weeks

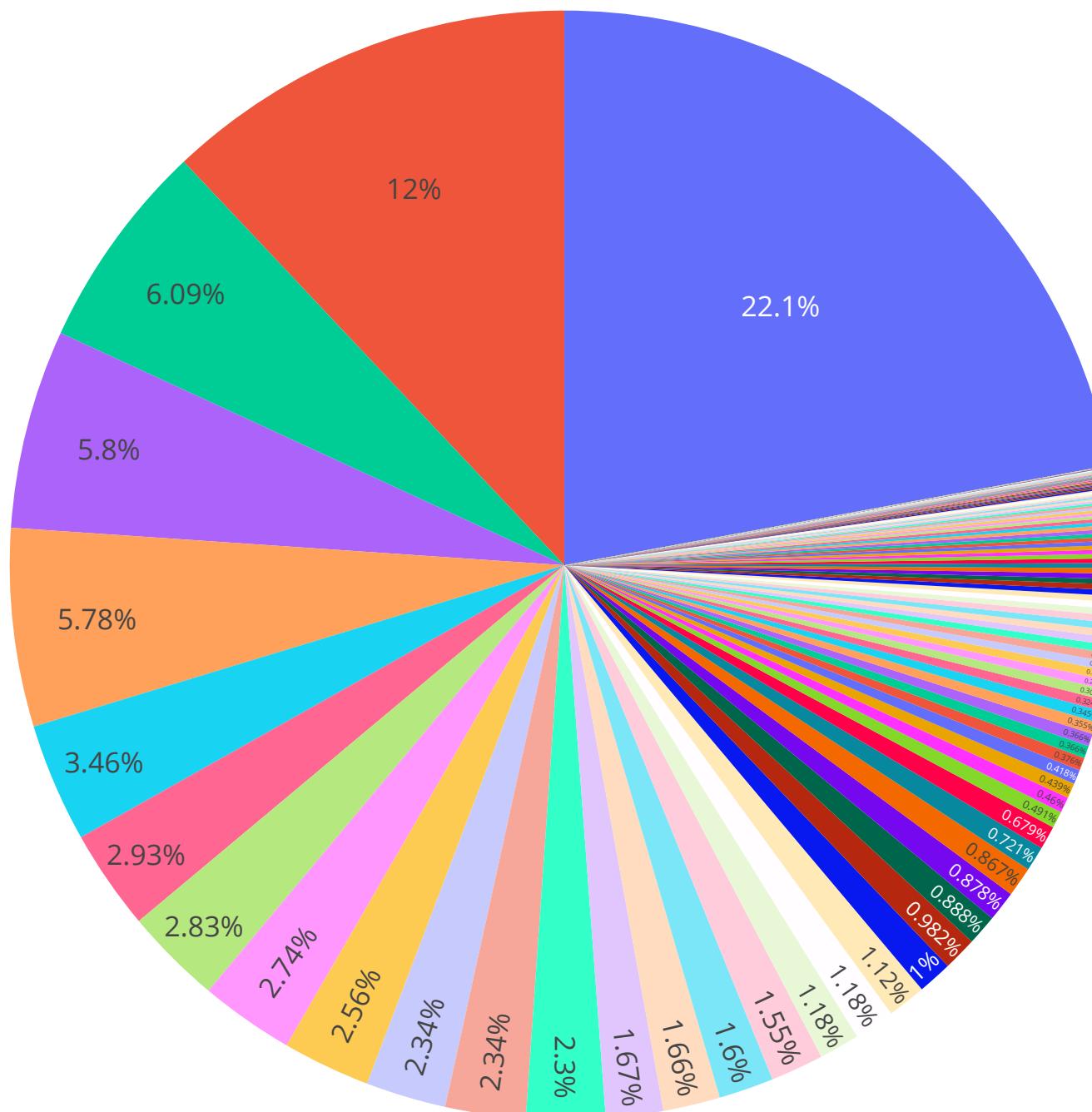


# Where is Rust being used today?



## Where do you live?

(total responses = 9572)



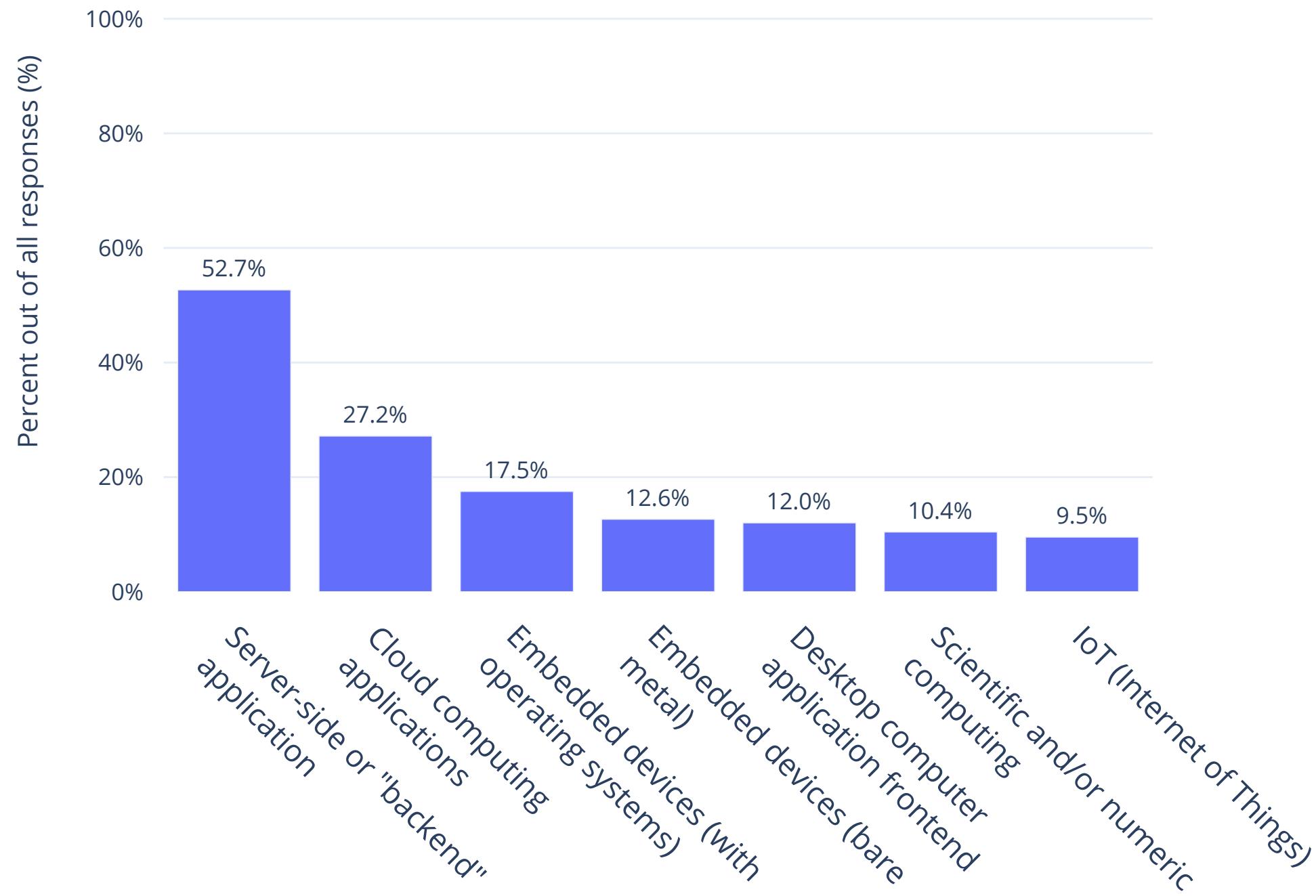
- United States of America
- Germany
- China
- United Kingdom of Great Britain and Northern Ireland
- France
- Canada
- Russian Federation
- Netherlands
- Japan
- Poland
- Australia
- Sweden
- India
- Brazil
- Switzerland
- Spain
- Italy
- Austria
- Czech Republic
- Norway
- Finland
- Denmark
- Ukraine
- Belgium
- Israel
- Hungary
- New Zealand
- ...

Source: Rust Annual 2023 survey



## In what technology domain(s) is Rust used at your organisation?

(total responses = 4139, multiple answers)



Not all answers are displayed

Source: Rust Annual 2023 survey



# Code at the speed of thought

Zed is a high-performance, multiplayer code editor from the creators of Atom and Tree-sitter. It's also open source.

gpubi.rs

crates/gpubi/src/gpubi.rs > pub trait Context > fn read\_model

```
147     where
148         T: 'static;
149
150     /// Update a window for the given handle.
151     fn update_window<T, F>(&mut self, window: AnyWindow)
152     where
153         F: FnOnce(AnyView, &mut WindowContext<'_>) ->
154             // ...
155         /// Read a window off of the
156         fn read_window<T, R>(
157             &self,
158             window: &WindowHandle<T>
159             read: impl FnOnce(View<T>)
160         ) -> Result<R>
161     where
162         T: 'static;
163     } trait Context
164
165     /// This trait is used for the different visual contexts
166     /// require a window to be present.
```

zed — zsh    zed — zsh    zed — zsh

Checking assistant v0.1.0 (/Users/natebutler/Code/zed/zed/c



# Make Ship Happen

Turbo is an incremental bundler and build system optimized for JavaScript and TypeScript, written in Rust.



## TURBOREPO

High-performance build system for JavaScript and TypeScript codebases.

BETA



## TURBOPACK

Introducing the Rust-powered successor to Webpack.



VERSION  
v0.4.3

RUFF

# Lint at lightspeed

An extremely fast Python linter, written in Rust.



Rust *anywhere*



# Rust *anywhere*

- Linux, Windows, macOS, ...



# Rust *anywhere*

- Linux, Windows, macOS, ...
- Cloud, backend, frontend, desktop, mobile, ...



# Rust *anywhere*

- Linux, Windows, macOS, ...
- Cloud, backend, frontend, desktop, mobile, ...
- From embedded devices to supercomputers



# Rust *anywhere*

- Linux, Windows, macOS, ...
- Cloud, backend, frontend, desktop, mobile, ...
- From embedded devices to supercomputers
- Code reuse



# Rust *anywhere*

- Linux, Windows, macOS, ...
- Cloud, backend, frontend, desktop, mobile, ...
- From embedded devices to supercomputers
- Code reuse
- Interoperable with C, C++, Python, WebAssembly, ...



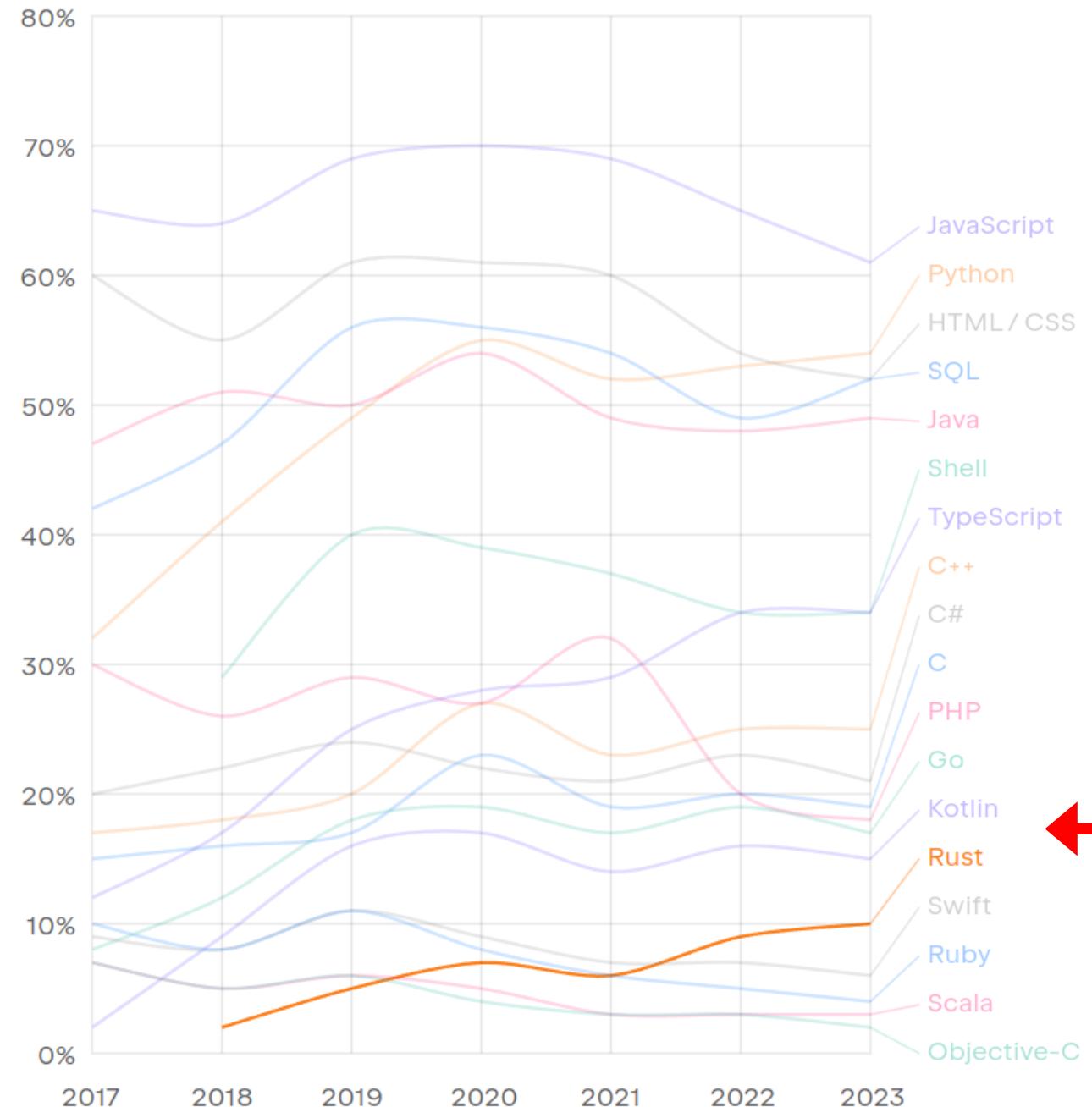
# Adoption of Rust



...



## Which programming, scripting, and markup languages have you used in the last 12 months?



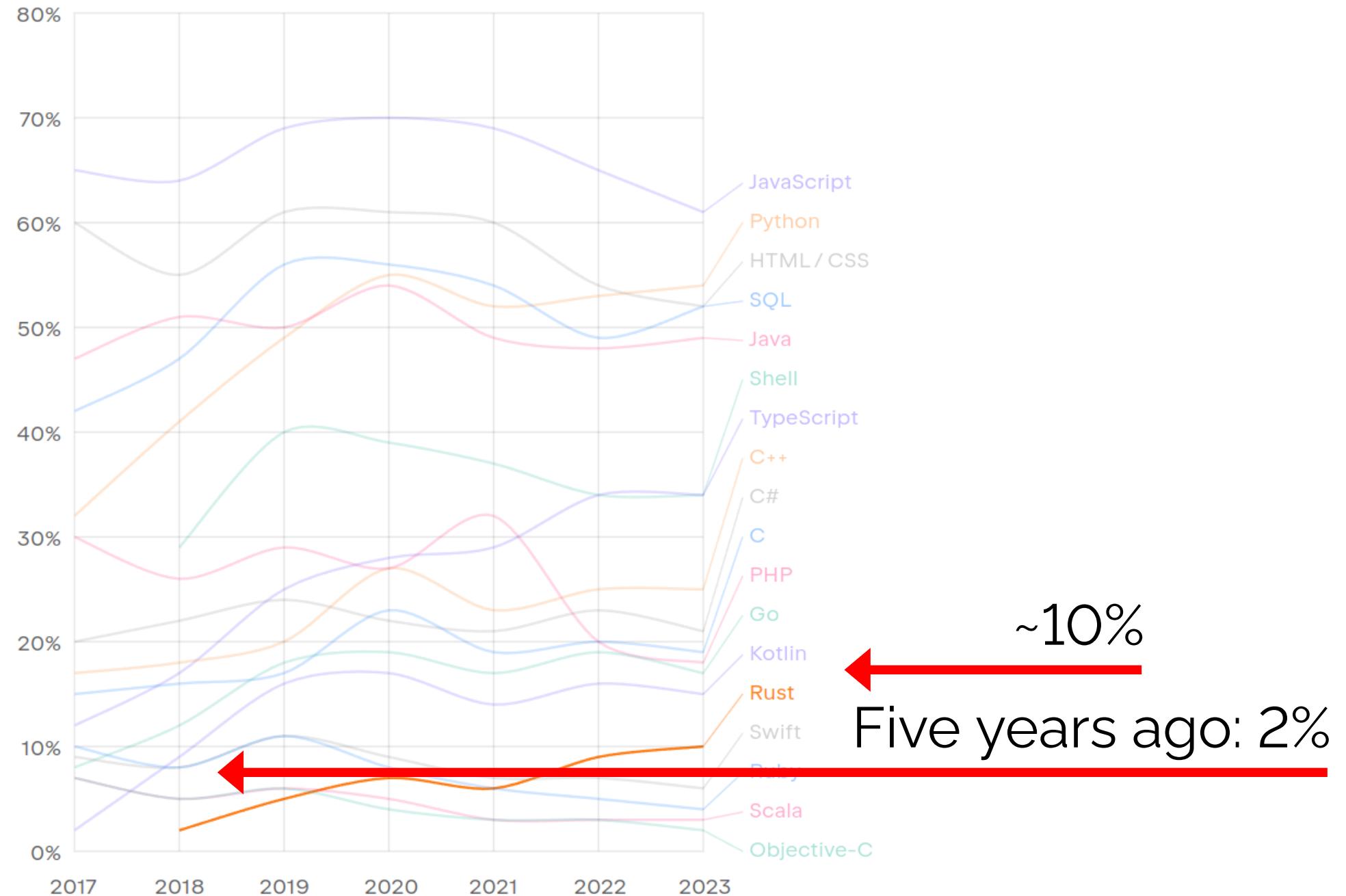
~10%



Source: The State of Developer Ecosystem in 2023 (JetBrains)



## Which programming, scripting, and markup languages have you used in the last 12 months?



Source: The State of Developer Ecosystem in 2023 (JetBrains)



# Package ecosystem size

Source: [crates.io](https://crates.io), [pypistats.org](https://pypistats.org), [all-the-package-names](https://all-the-package-names.com)



# Package ecosystem size

- Rust ~150k



# Package ecosystem size

- Rust ~150k
- Python ~520k

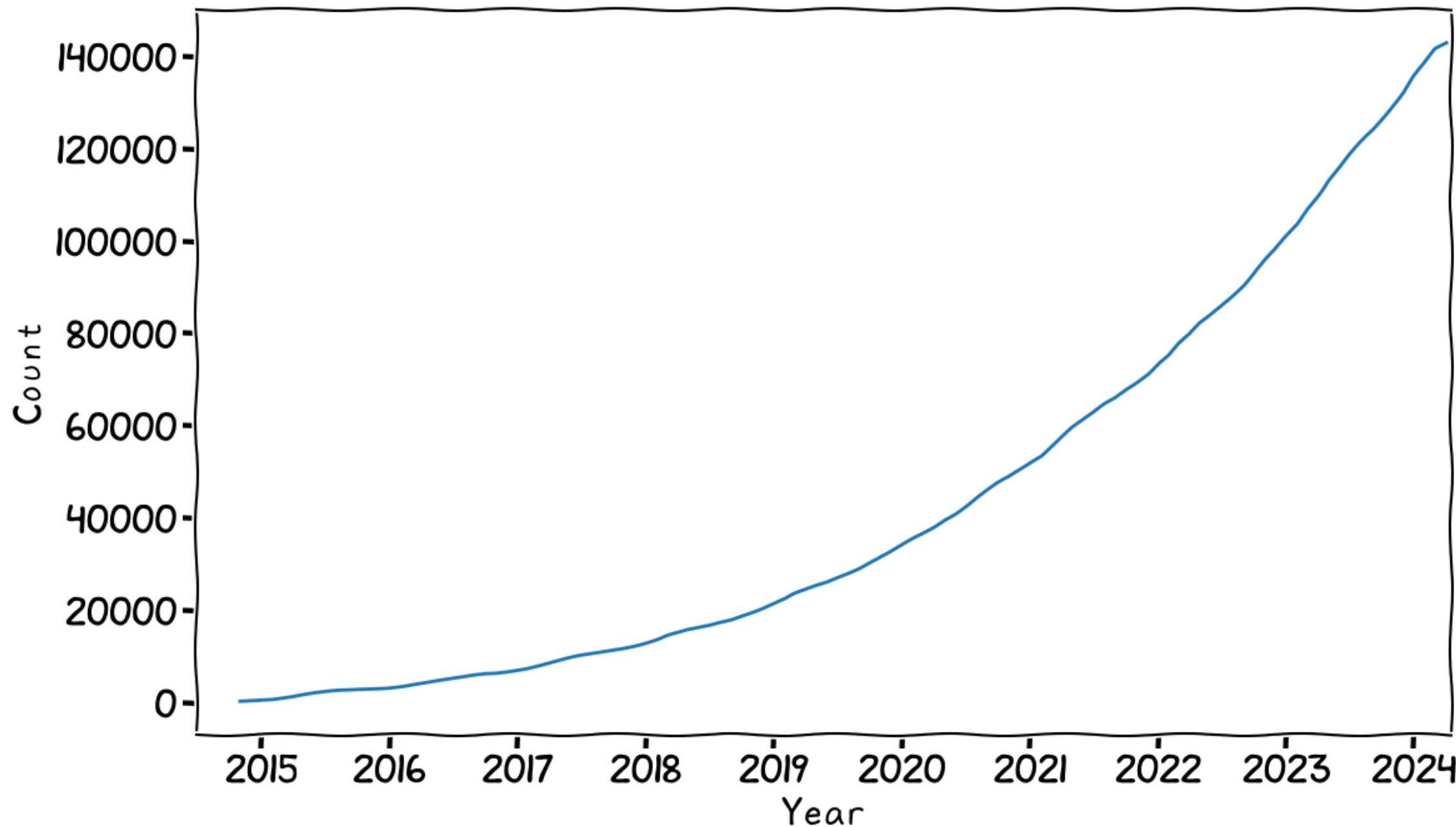


# Package ecosystem size

- Rust ~150k
- Python ~520k
- JavaScript ~2,800k



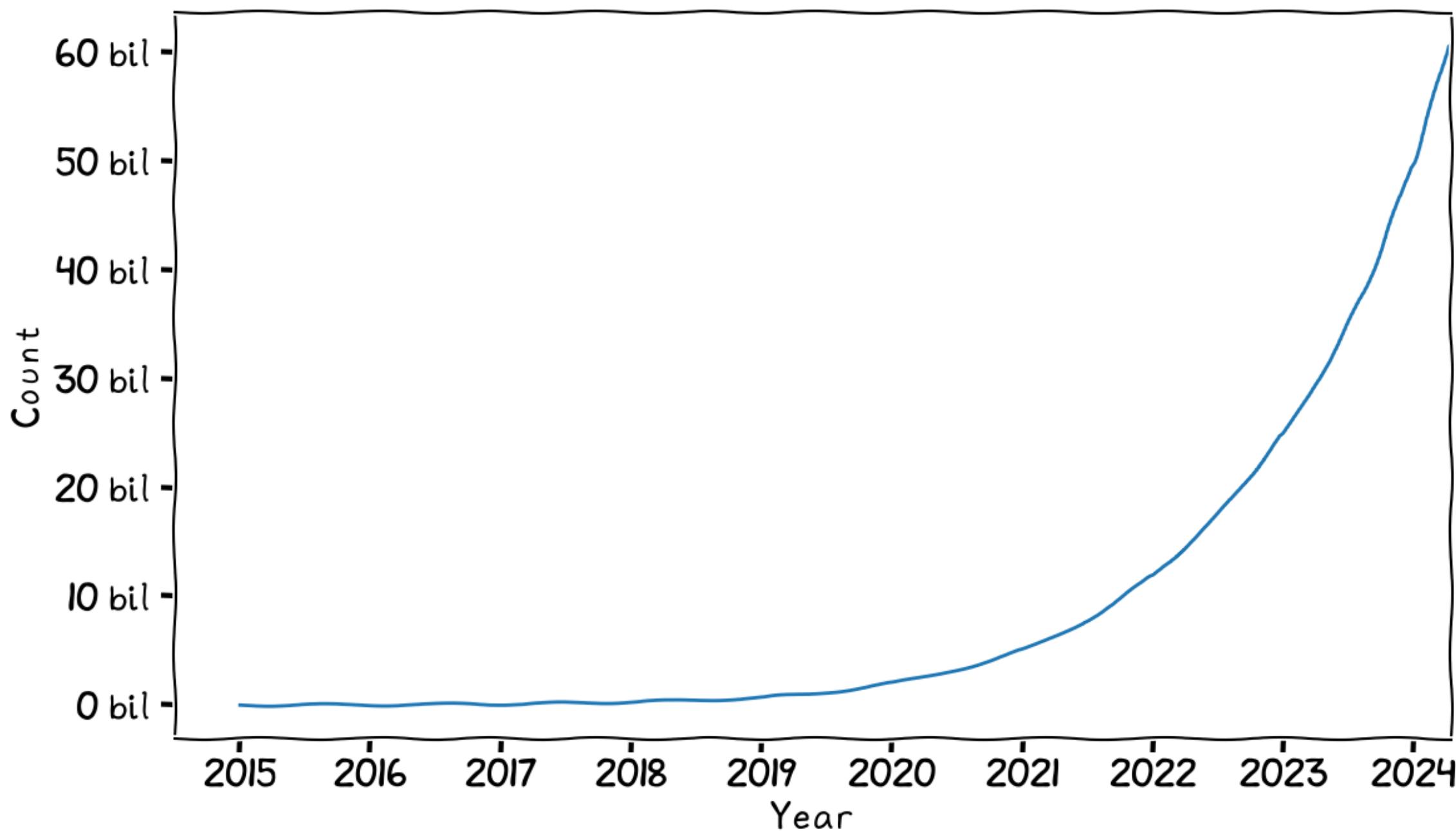
## Number of Rust packages (150k+)



Source: [crates.io](https://crates.io)



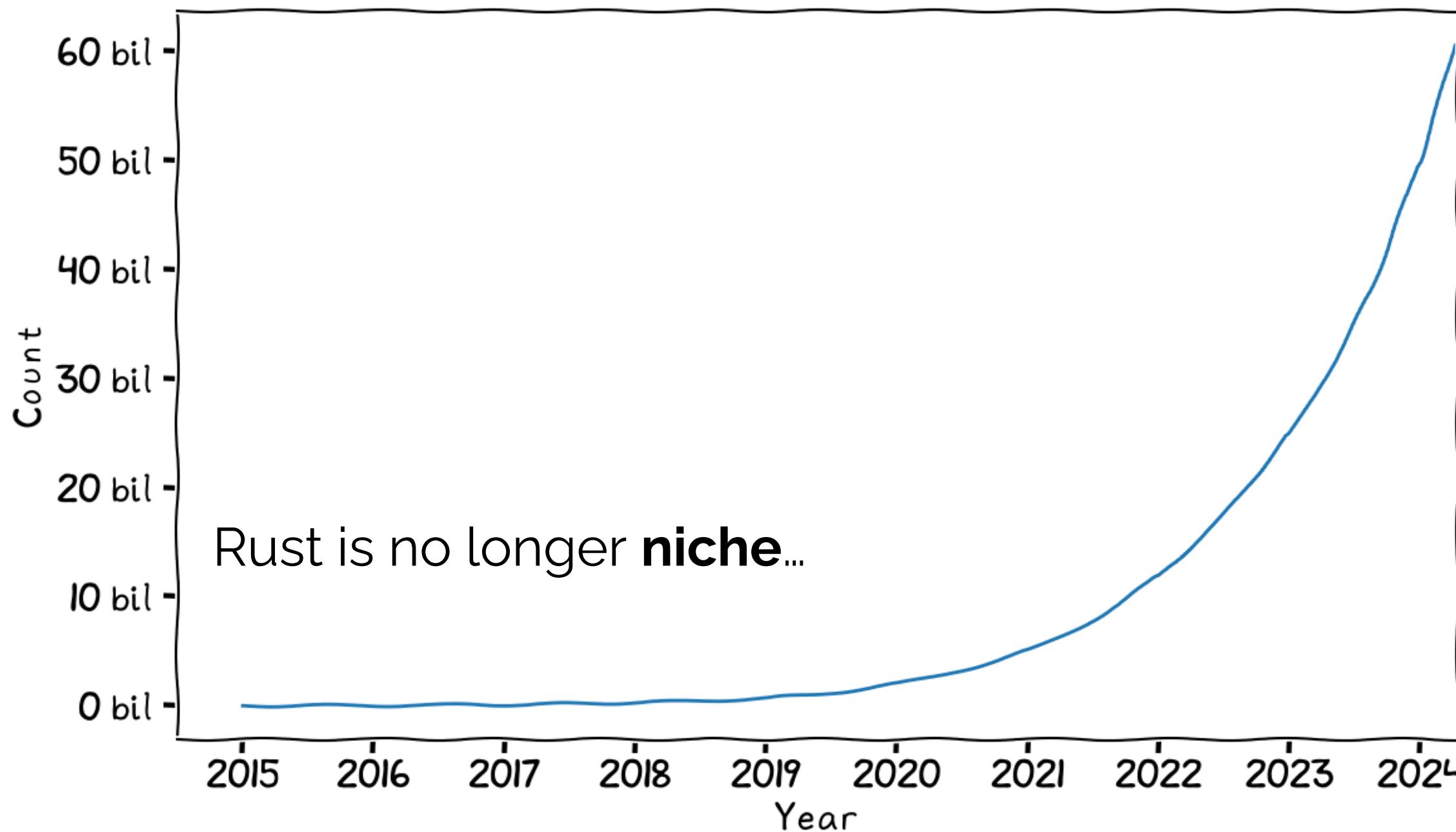
## Rust package downloads (80B+)



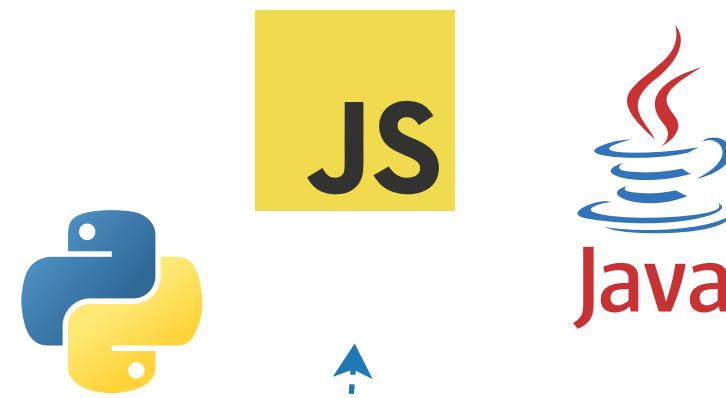
Source: crates.io



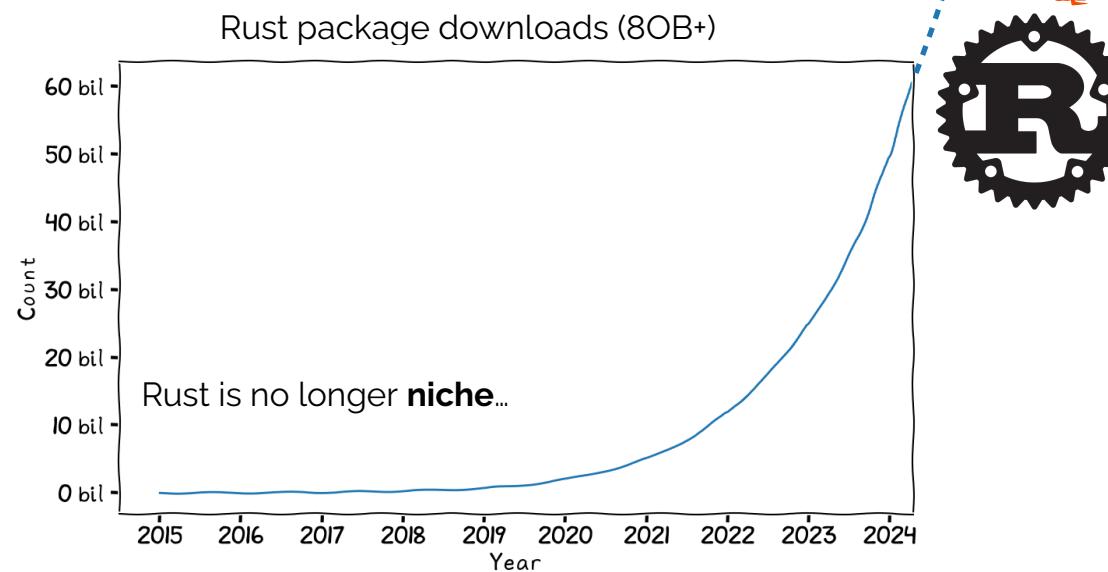
## Rust package downloads (80B+)



Source: crates.io



...but it is not yet fully **mainstream**.



Source: crates.io



# Thanks for your attention

Slides were created using [github.com/spiral1/elsie](https://github.com/spiral1/elsie)