Scientific Computing With Rust

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April 13, 2022

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Team and Research Focus

Research Focus:

1. Numerical Analysis & Scientific Computing
2. PDEs: Acoustics, Electromagnetics, Electrostatics
3. High-Performance Computing and Software Engineering

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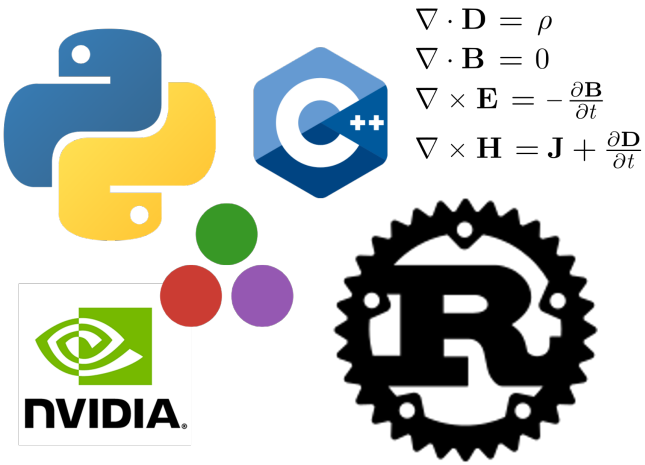
https://github.com/betckegroup

My Research

'Science with Computers and Maths'

1. High Performance Computing
2. Heterogenous Computing
3. Software Engineering
4. Problems in Physics and Engineering



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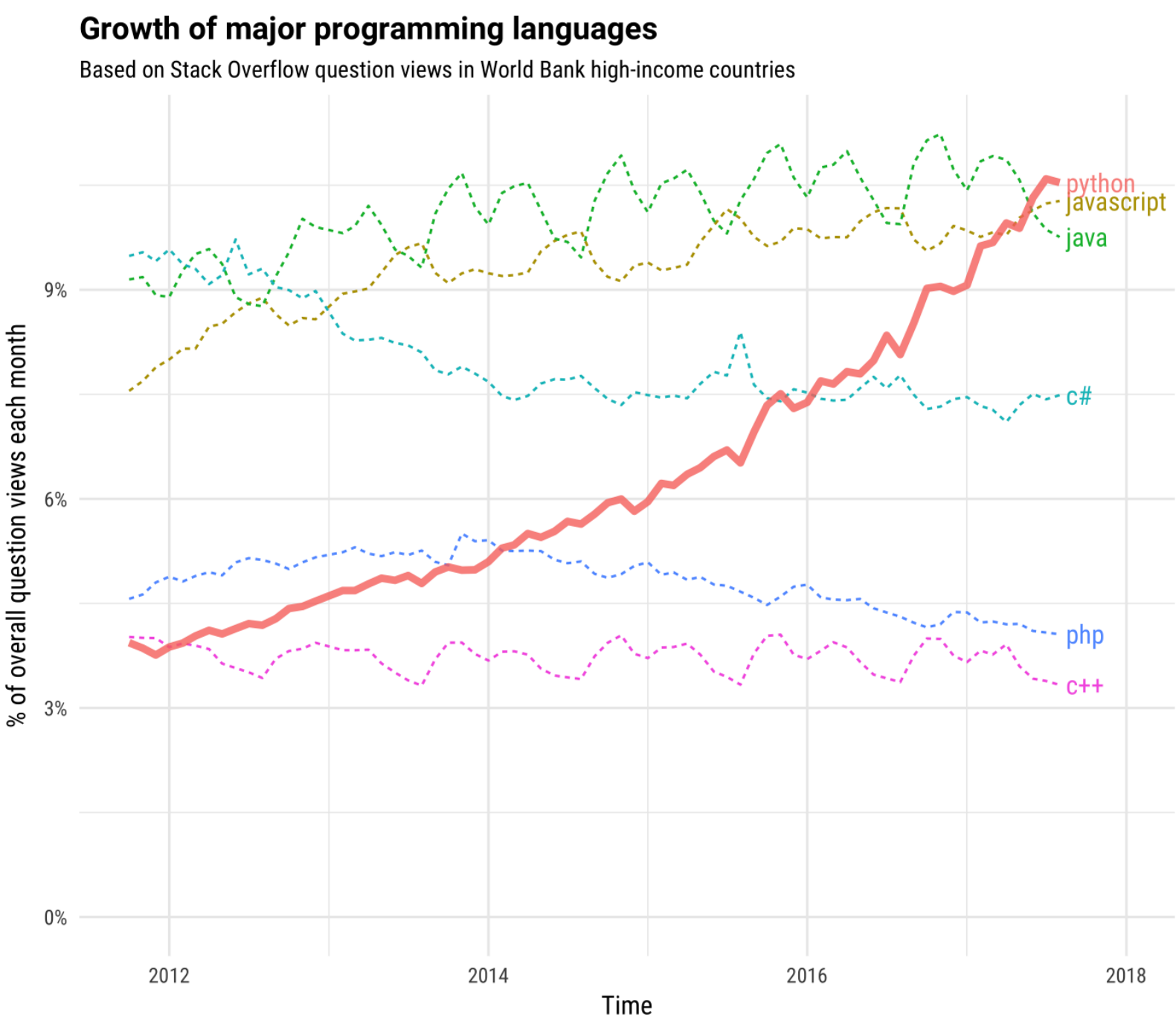
Expressing Scientific Problems With Software

There is no ‘best’ language for expressing scientific problems with software.

Though Python has emerged as a defacto standard amongst scientists and engineers for a broad spectrum of problems.



https://stackoverflow.blog/2017/09/06/incredible-growth-python/

The Two Language Problem

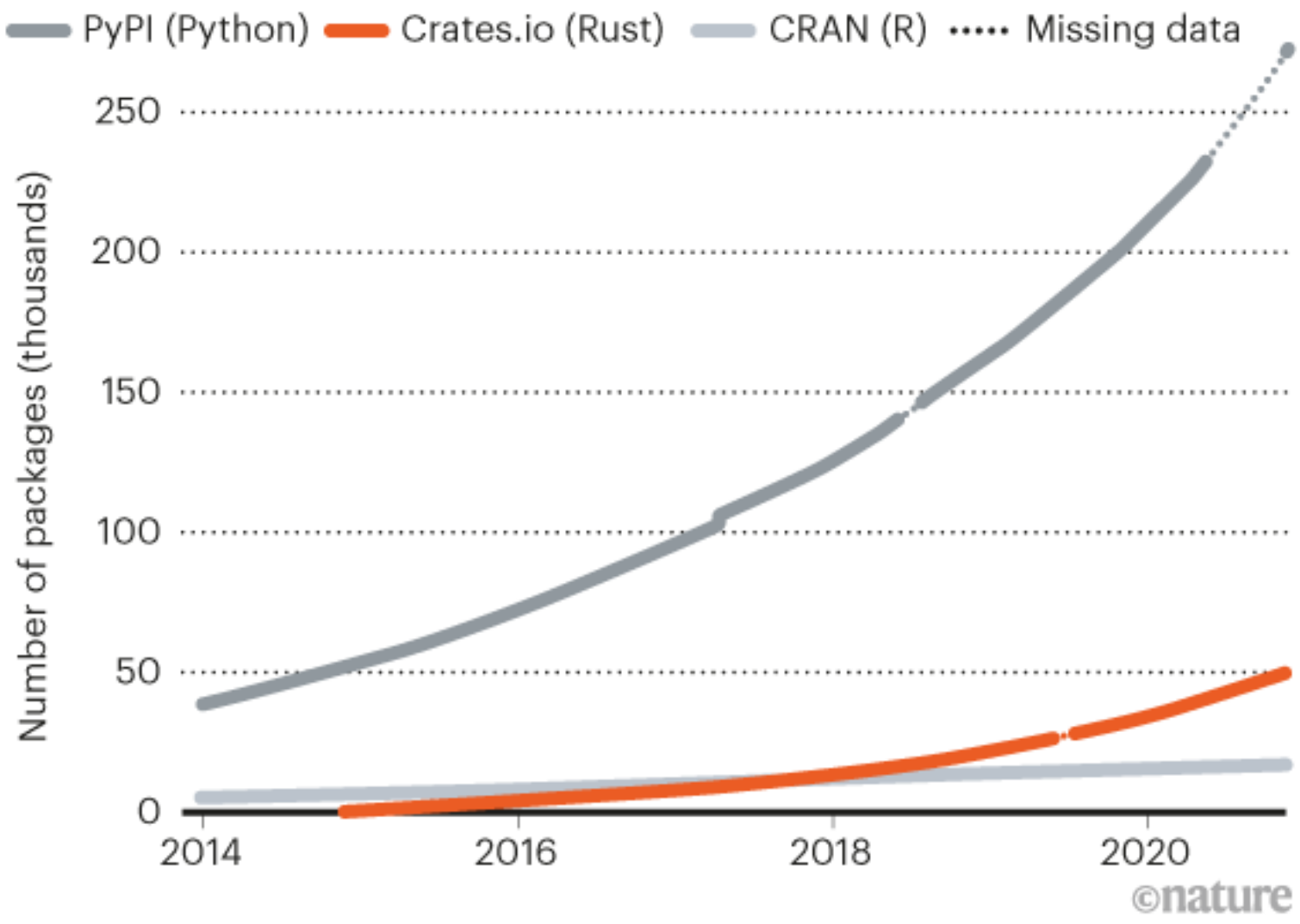
1. Languages suited for human needs, are less efficient for computers to run.
2. Languages easy for computers to run efficiently, are correspondingly less easy for humans to use!

Why Rust?

Don't many of the 'two language' problems still exist?

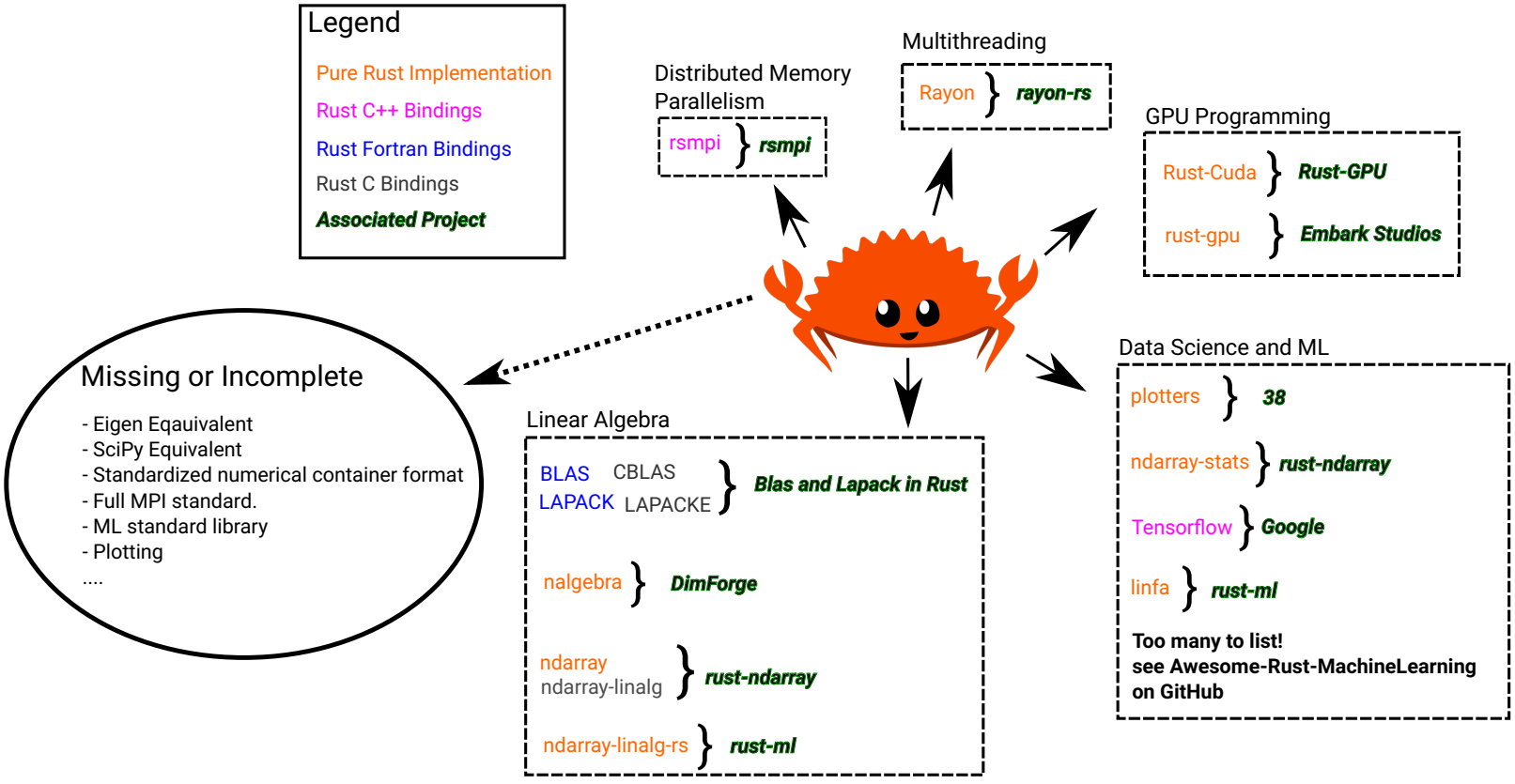
Pros of Rust:

1. Cargo is awesome!
2. Rust is Fast
3. Foreign language interfaces are easy
4. Easy to learn (harder to master)
5. Traits
6. Borrow Checker



https://www.nature.com/articles/d41586-020-03382-2

State of Scientific Computing in Rust



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A Splash of Differential Equations

What is an Ordinary Differential Equation?

Imposition of a relationship between functions of a independent single variable and its derivatives.

e.g. Newton's Second Law of Motion (in 1 Dimension)

$$m\frac{d^2x}{dt^2} = F(x(t)) \tag{1}$$

A Splash of Differential Equations

What is a Partial Differential Equation?

Imposition of a relationship between functions of a multiple independent variables and their derivatives.

e.g. The Heat Equation (in 3D Cartesian Coordinates, $\Delta = \frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2}$)

$$\frac{du}{dt} = \Delta u \tag{2}$$

Where $u(x, y, z, t)$.

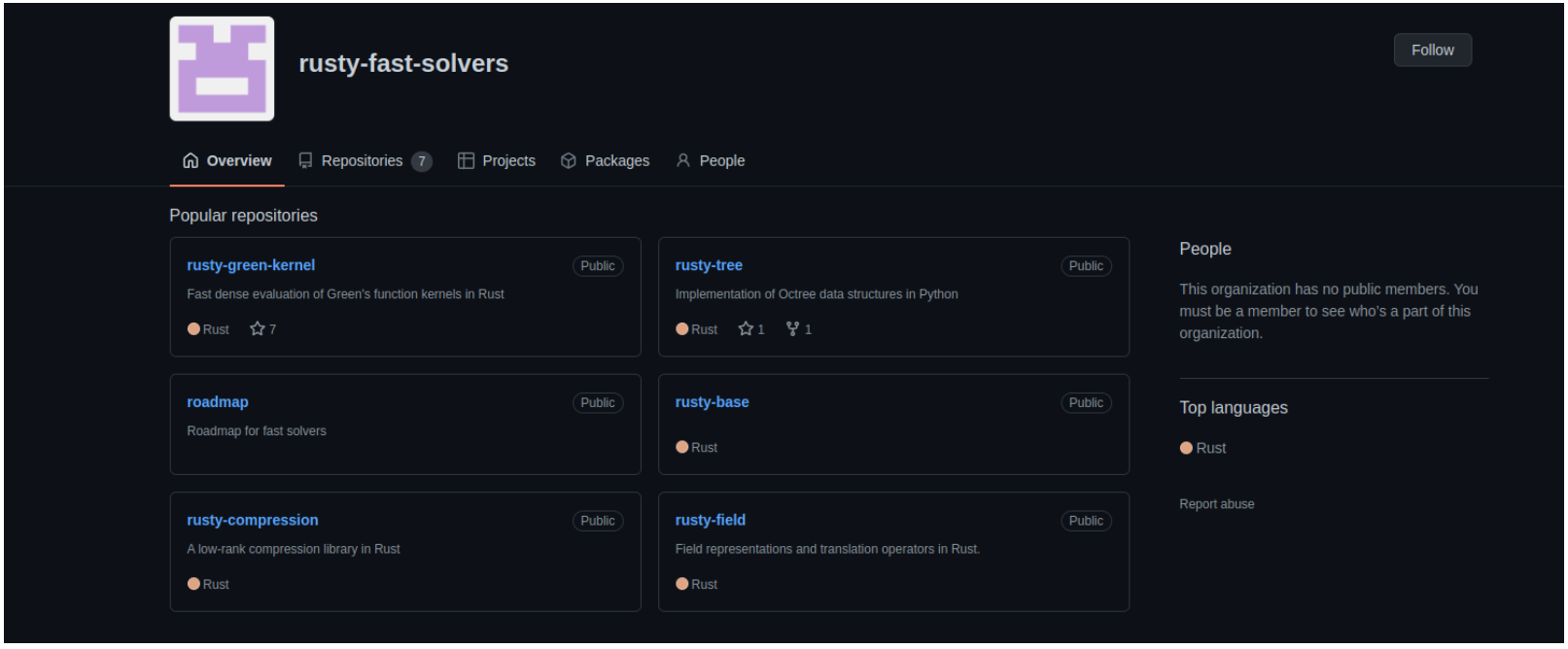
BEM

Problems with BEM

FMM

Fast Direct Solvers

Rusty Fast Solvers Project



https://github.com/rusty-fast-solvers

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