

Scientific Computing With Rust

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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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Srinath Kailasa
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My Research

'Science with Computers and Maths'

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

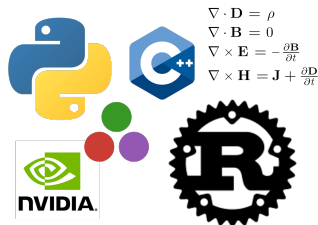


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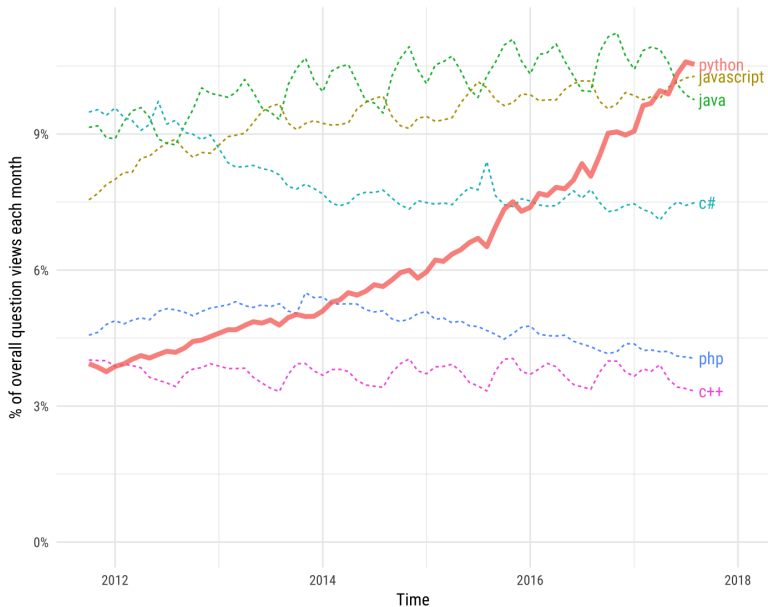
Expressing Scientific Problems With Software

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.

Growth of major programming languages

Based on Stack Overflow question views in World Bank high-income countries



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?

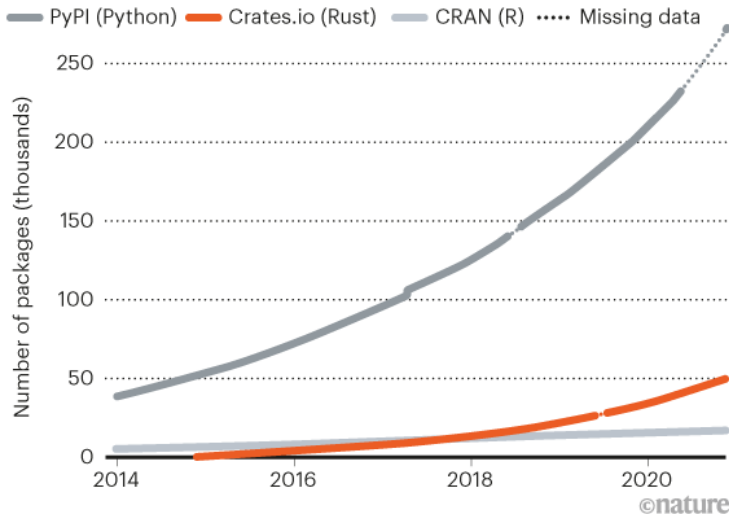
Don't many of the 'two language' problems still exist?

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

RUST RISING

The Rust packages repository crates.io has grown sharply since 2016, mirroring the rapid uptake of the language.



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

State of Scientific Computing in Rust

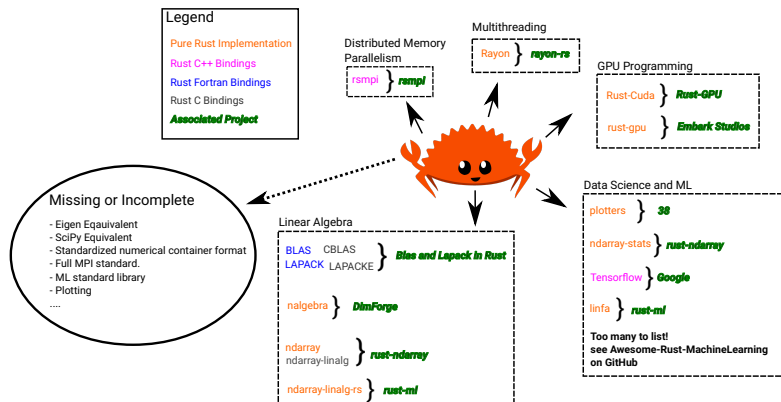


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A Splash of Differential Equations

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)

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

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,

$$\Delta = \frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2})$$

$$\frac{du}{dt} = \Delta u \quad (2)$$

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

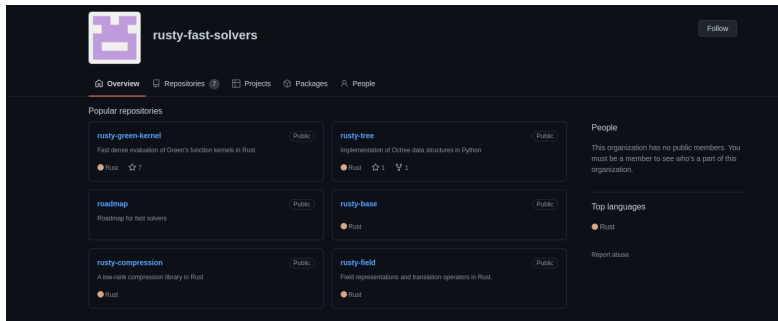
BEM

Problems with BEM

FMM

Fast Direct Solvers

Rusty Fast Solvers Project



The screenshot shows the GitHub organization page for 'rusty-fast-solvers'. At the top, there is a purple logo and the organization name. Below this is a navigation bar with tabs for Overview, Repositories, Projects, Packages, and People. The main content area is titled 'Popular repositories' and displays a grid of repository cards. Each card includes the repository name, a brief description, a 'Public' badge, a Rust language icon, and statistics like stars and forks. On the right side, there are sections for 'People' (stating no public members), 'Top languages' (showing Rust), and a 'Report abuse' link.

rusty-fast-solvers Follow

[Overview](#) [Repositories](#) [Projects](#) [Packages](#) [People](#)

Popular repositories

- rusty-green-kernel** Public
Fast dense evaluation of Green's function kernels in Rust
● Rust ☆ 7
- rusty-tree** Public
Implementation of Octree data structures in Python
● Rust ☆ 1 🍴 1
- roadmap** Public
Roadmap for fast solvers
- rusty-base** Public
● Rust
- rusty-compression** Public
A low-rank compression library in Rust
● Rust
- rusty-field** Public
Field representations and translation operators in Rust.
● Rust

People
This organization has no public members. You must be a member to see who's a part of this organization.

Top languages
● Rust

[Report abuse](#)

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

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