So you heard about Julia?

Cédric Simal

Unamur, Naxys

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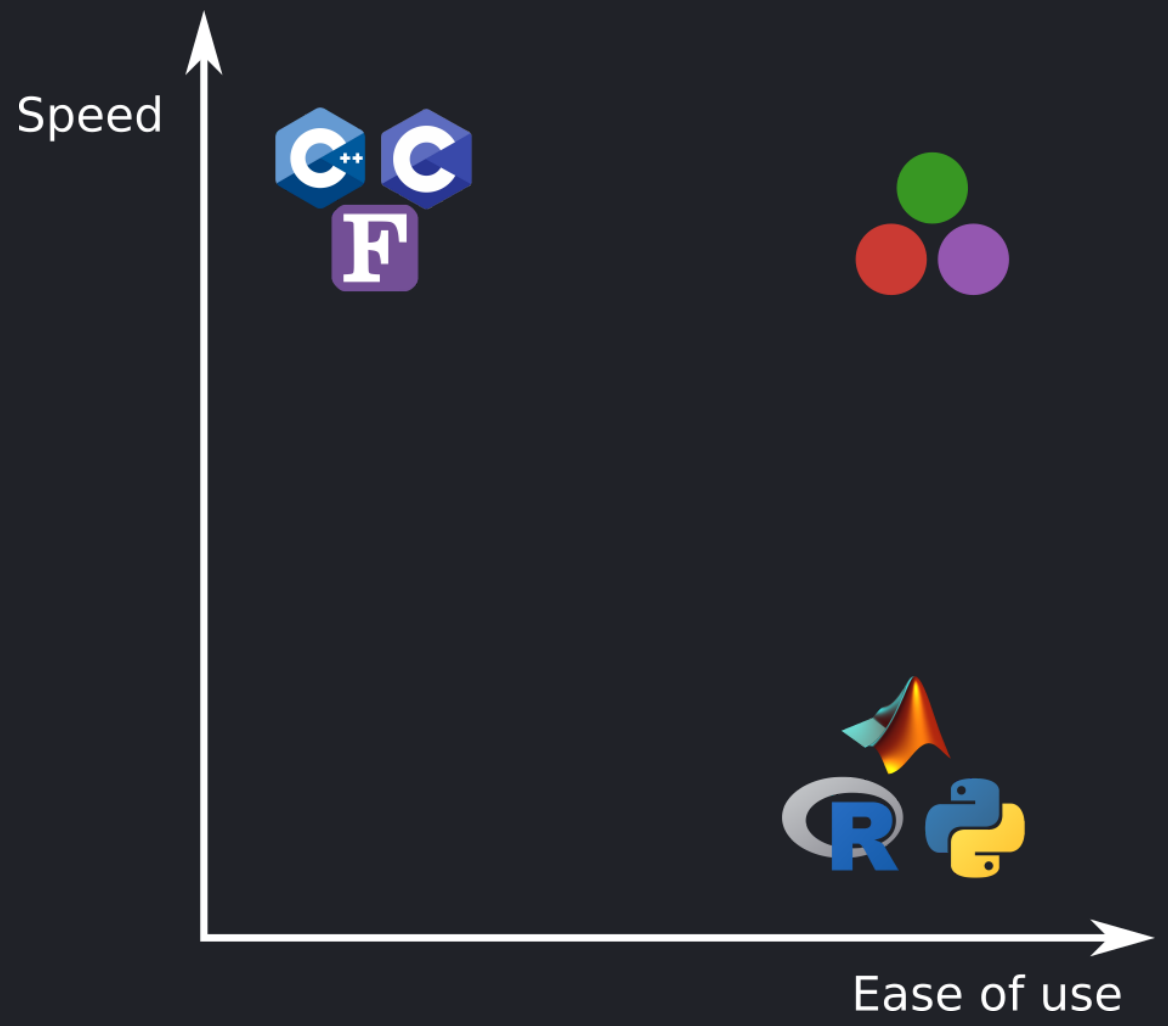
Motivation

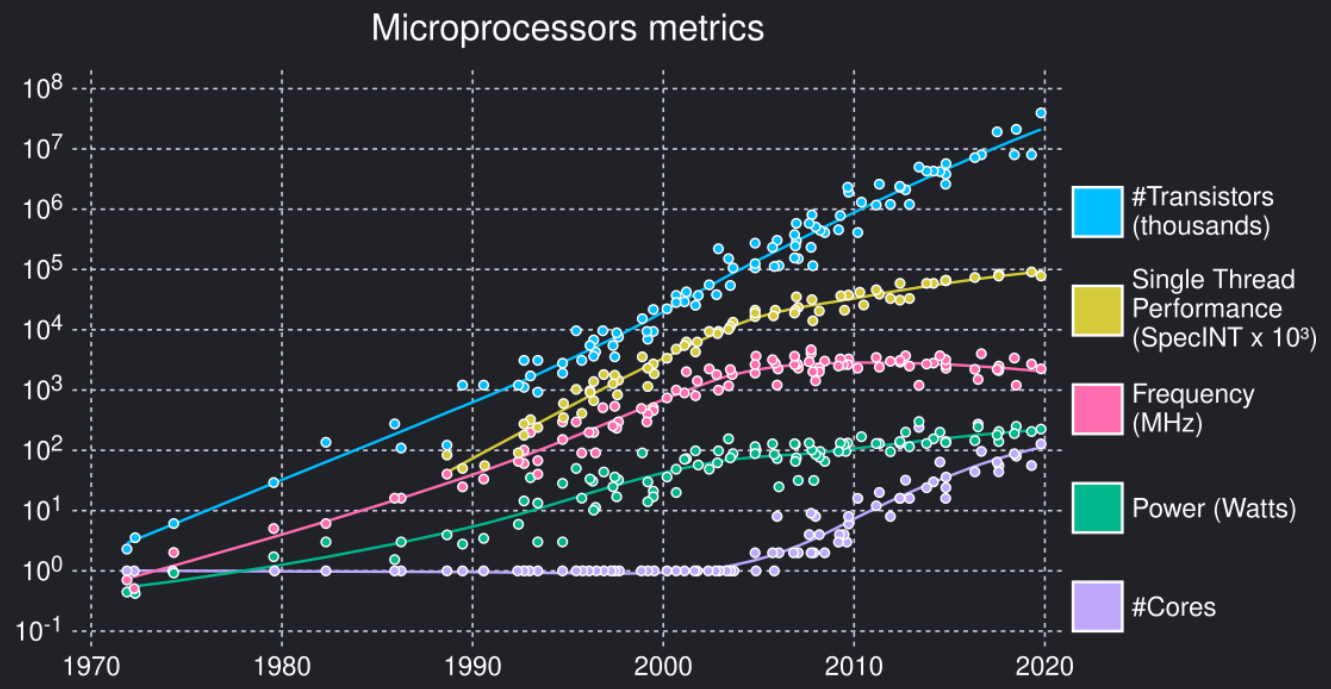
Outline

1. Modern problems in scientific computing
2. What is Julia and how does it work
3. The Julia package ecosystem

The two languages problem



The rise of parallel computing



data: https://github.com/karlrupp/microprocessor-trend-data

Meet Julia

Julia: A Fast Dynamic Language for Technical Computing

Jeff Bezanson* MIT
Stefan Karpinski† MIT
Viral B. Shah‡
Alan Edelman§ MIT

September 25, 2012

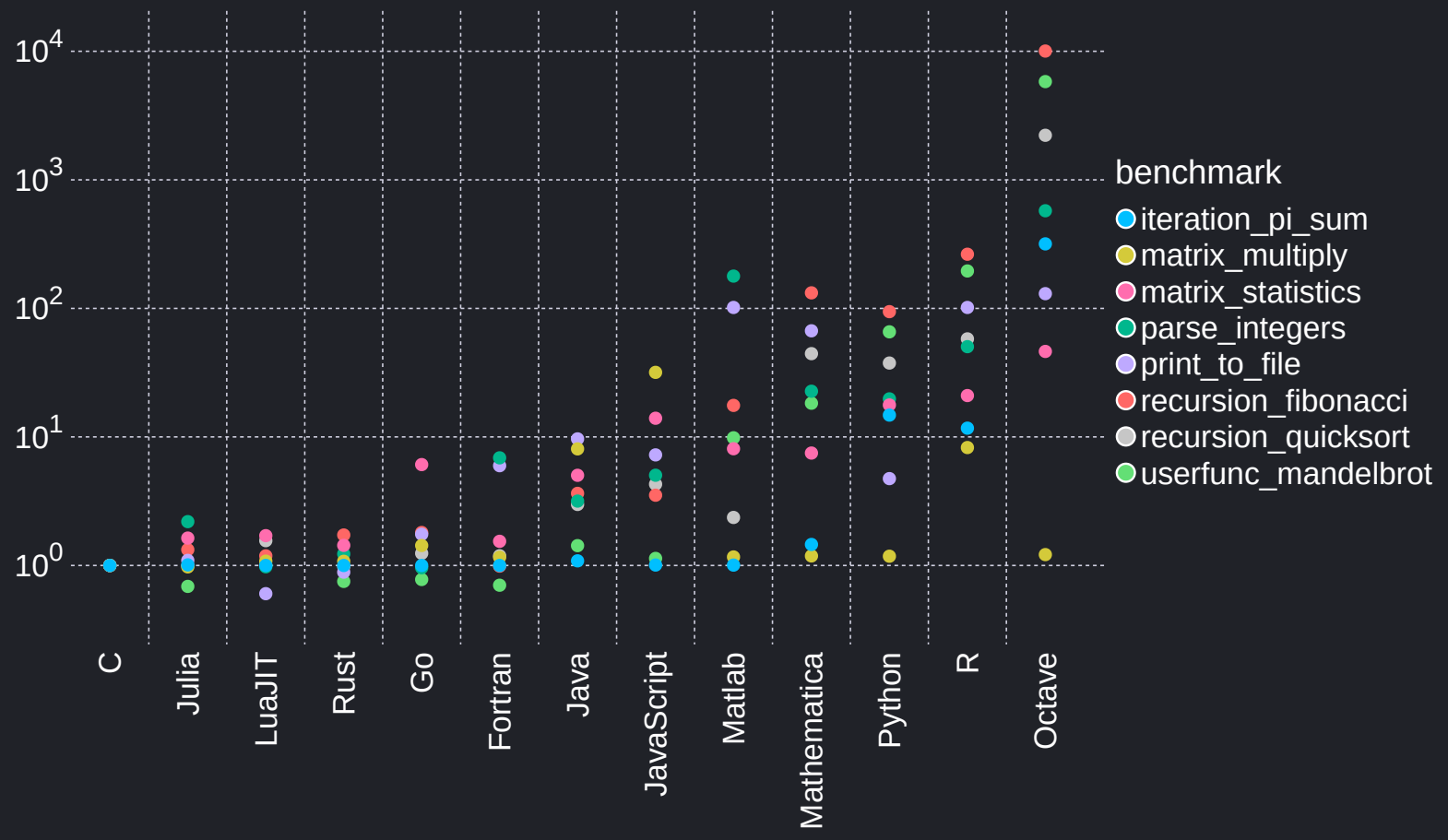
Abstract

Dynamic languages have become popular for scientific computing. They are generally considered highly productive, but lacking in performance. This paper presents Julia, a new dynamic language for technical computing, designed for performance from the beginning by adapting and extending modern programming language techniques. A design based on generic functions and a rich type system simultaneously enables an expressive programming model and successful type inference, leading to good performance for a wide range of programs. This makes it possible for much of Julia's library to be written in Julia itself, while also incorporating best-of-breed C and Fortran libraries.

A short history of Julia

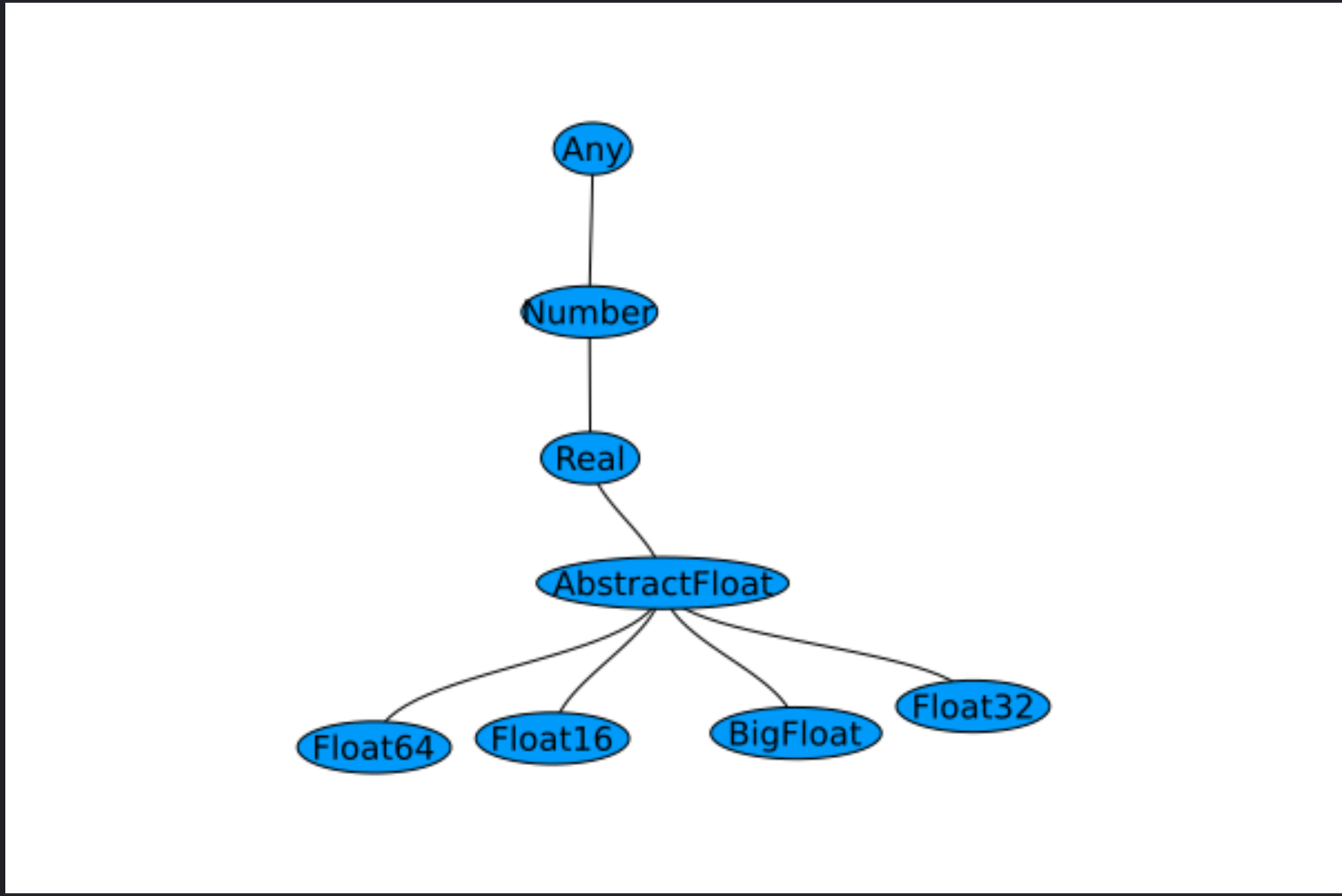
2009	2012	2014	2017	2018	2019	2020	2021
	Official announcement	0.3	0.6 Celeste Project	1.0	1.1 1.2 1.3	1.4 1.5	1.6 1.7

Julia is fast



https://julialang.org/benchmarks/

Types


Any
Number
Real
AbstractFloat
Float64
Float16
BigFloat
Float32

Type System

Julia's type system is

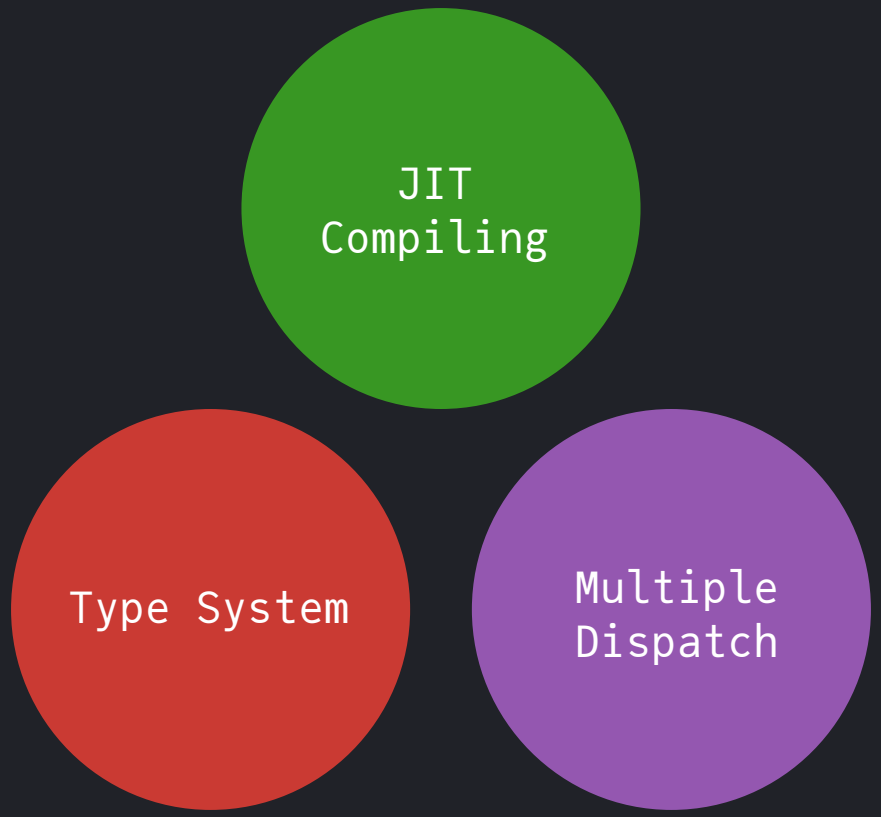
- Dynamic, with optional type annotations `x::Int`
- Parametric `Vector{T}`
- Hierarchical (subtyping) `Float64 <: Real`

Multiple Dispatch

```
julia> +
+ (generic function with 198 methods)

julia> methods(+)
# 198 methods for generic function "+":
[1] +(x::Bool, z::Complex{Bool}) in Base at complex.jl:282
[2] +(x::Bool, y::Bool) in Base at bool.jl:96
[3] +(x::Bool) in Base at bool.jl:93
[4] +(x::Bool, y::T) where T<:AbstractFloat in Base at bool.jl:104
[5] +(x::Bool, z::Complex) in Base at complex.jl:289
[6] +(a::Float16, b::Float16) in Base at float.jl:398
[7] +(x::Float32, y::Float32) in Base at float.jl:400
[8] +(x::Float64, y::Float64) in Base at float.jl:401
[9] +(z::Complex{Bool}, x::Bool) in Base at complex.jl:283
[10] +(z::Complex{Bool}, x::Real) in Base at complex.jl:297
...
```

The secret sauce behind Julia's speed

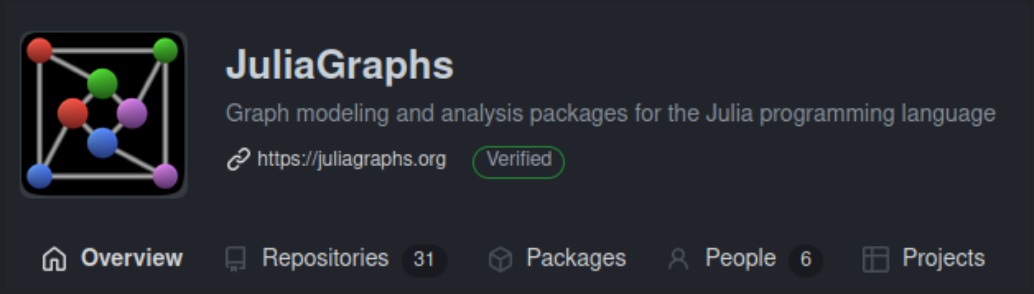


Postcard demo

Dynamical Systems

- DifferentialEquations
- DynamicalSystems

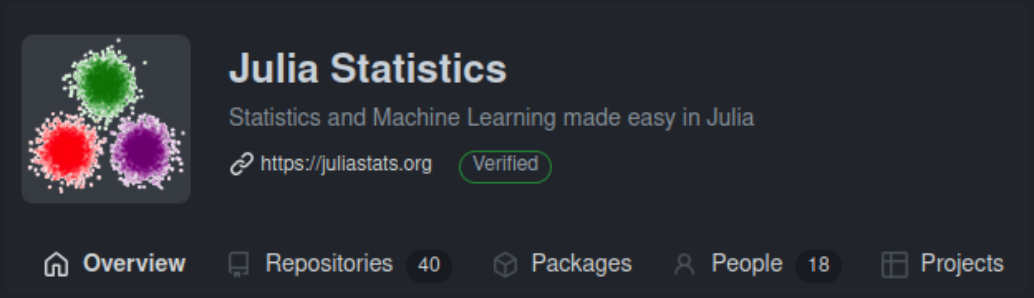

Friendship ended with
MATLAB
Now
julia
is my
best friend
imgflip.com



Networks

- Graphs
- NetworkDynamics
- SimpleHypergraphs
- Simplicial

Statistics


Julia Statistics
Statistics and Machine Learning made easy in Julia
https://juliastats.org
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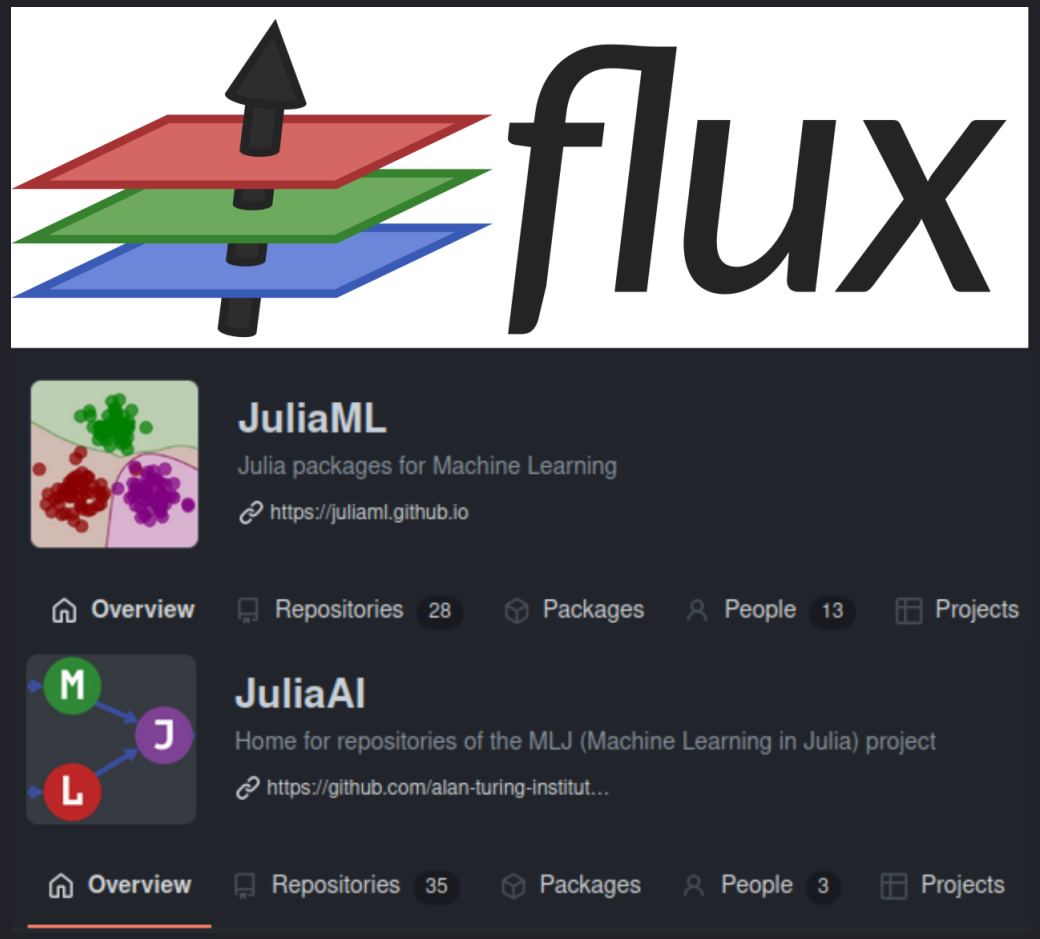
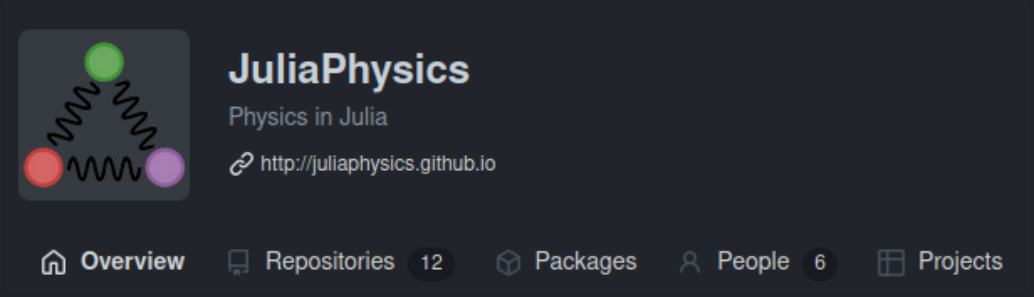


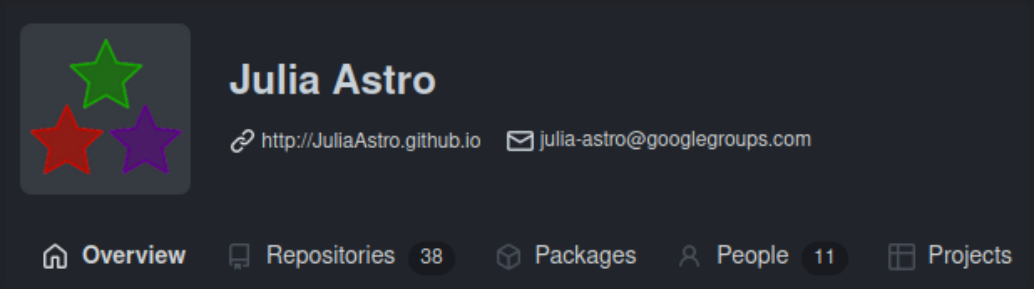
Machine Learning

Physics

QuantumOptics

Yao

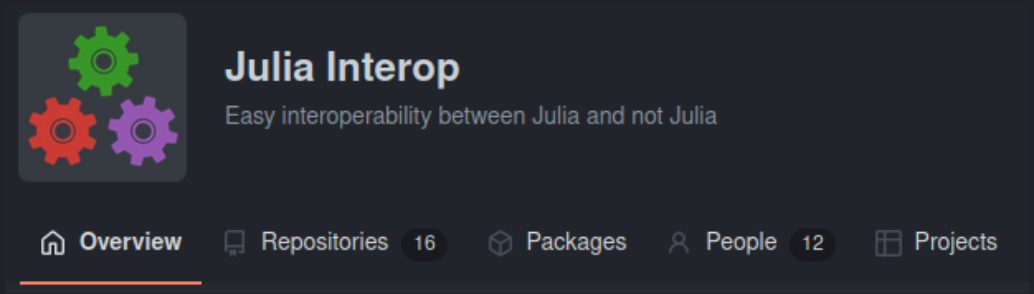




Astronomy & Aerospace

Optimization

Optim
GalacticOptim


Julia Interop
Easy interoperability between Julia and not Julia
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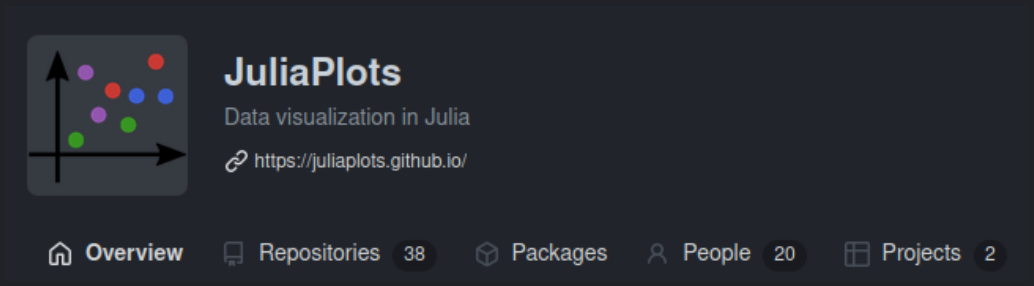
Interop

Plotting

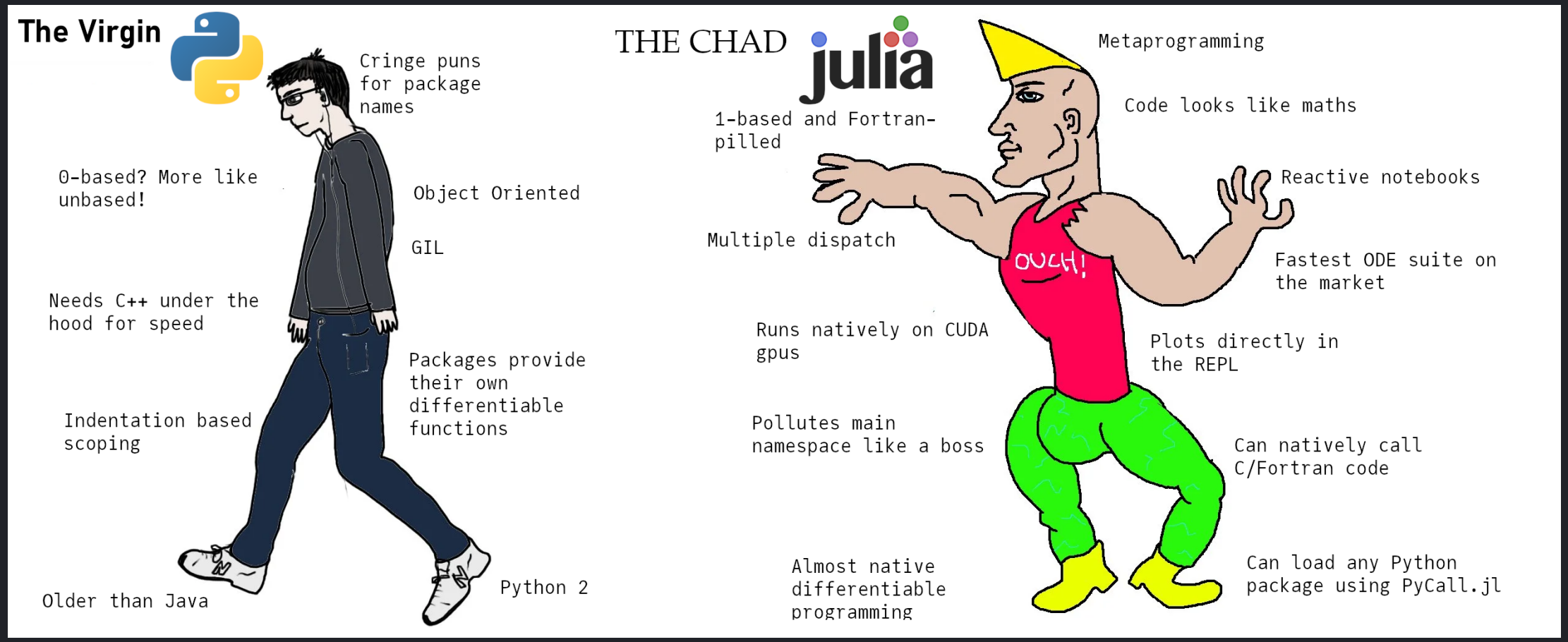
- Plots
- Gadfly
- Makie



Conclusions

- Compared to a year ago, Julia has grown tremendously
- It delivers on its promise to "Walk like Python. Run like C"
- Main challenge: reach critical mass

That's all folks!



https://github.com/csimal/Julia-Unamur