julia

The programming language for scientists

Carsten Bauer @ University of Cologne, October 2019

What does science need from a programming language?

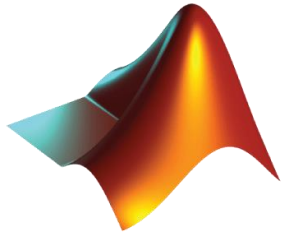
Easy to write and read !

Fast and scalable !

Interactive !

There’s a plethora of programming languages

There’s a plethora of programming languages



MATLAB

There’s a plethora of programming languages

Fast

Slow(ish)

MATLAB

There’s a plethora of programming languages

Compiled

Interpreted

There’s a plethora of programming languages

Static

Dynamic

There’s a plethora of programming languages

Speed

Convenience

MATLAB

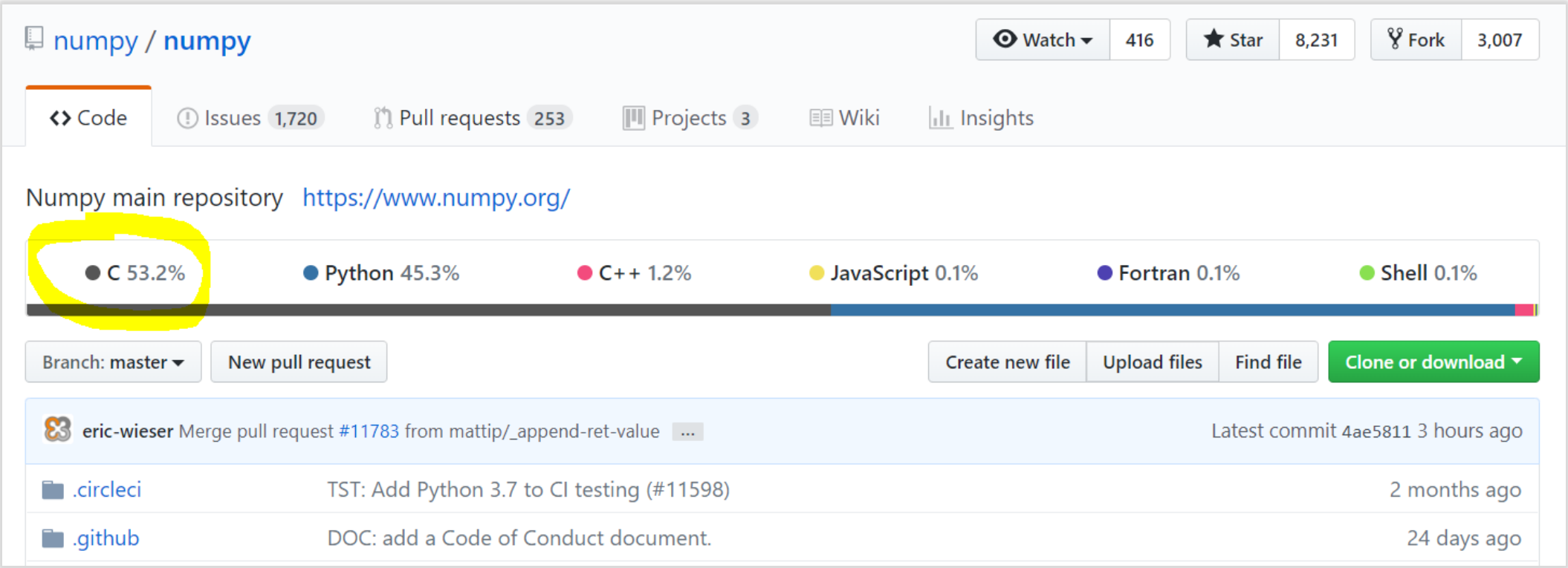
The “two language problem”

a.k.a Ousterhout's dichotomy

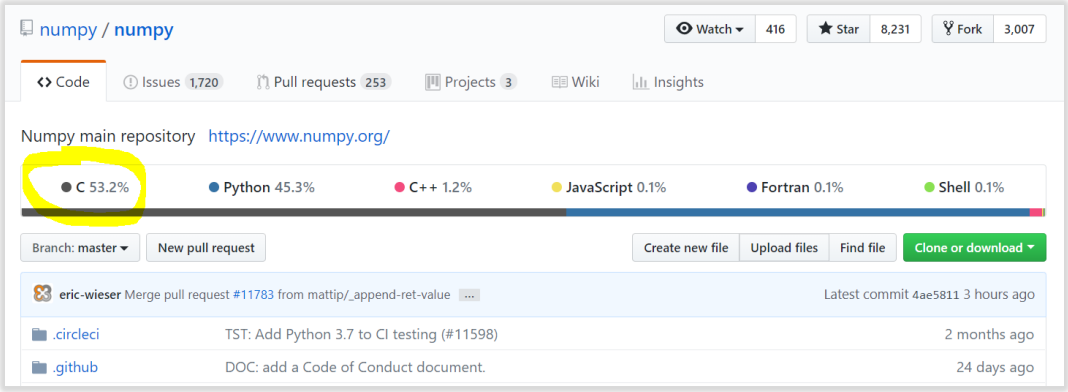
Prototype

Production

The “two language problem”

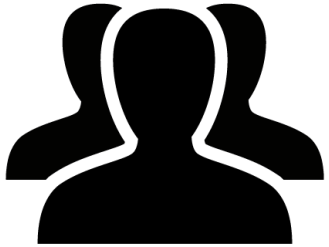


The “two language problem”



Developer

User



The “two language problem”

static	dynamic
compiled	interpreted
user types	standard types
standalone	glue

julia

dynamic

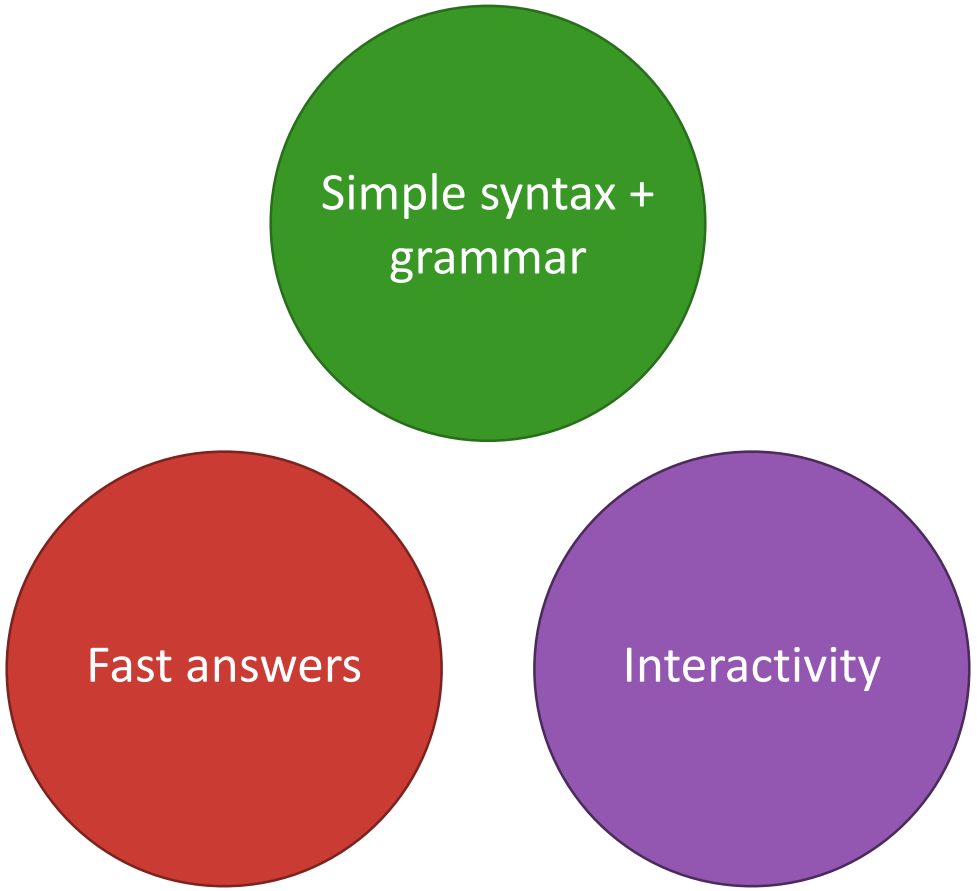
compiled

user types **and** standard types

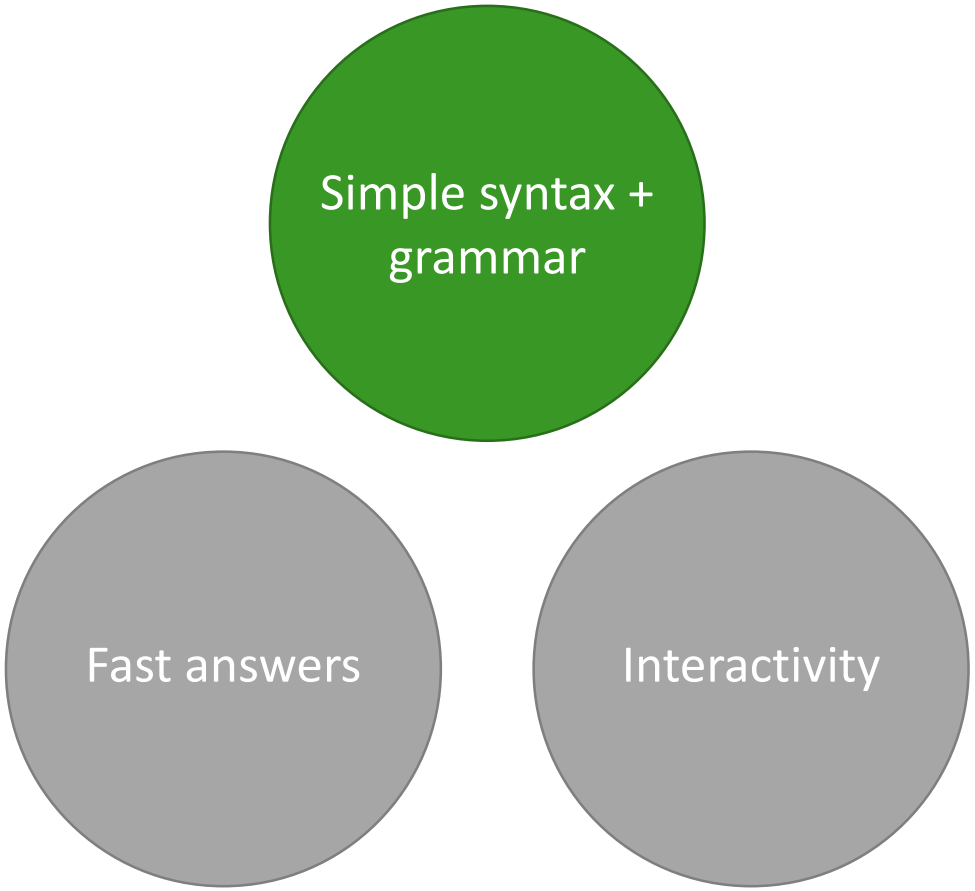
standalone **or** glue

“Feels like Python, runs like C”

The julia unification



The julia unification



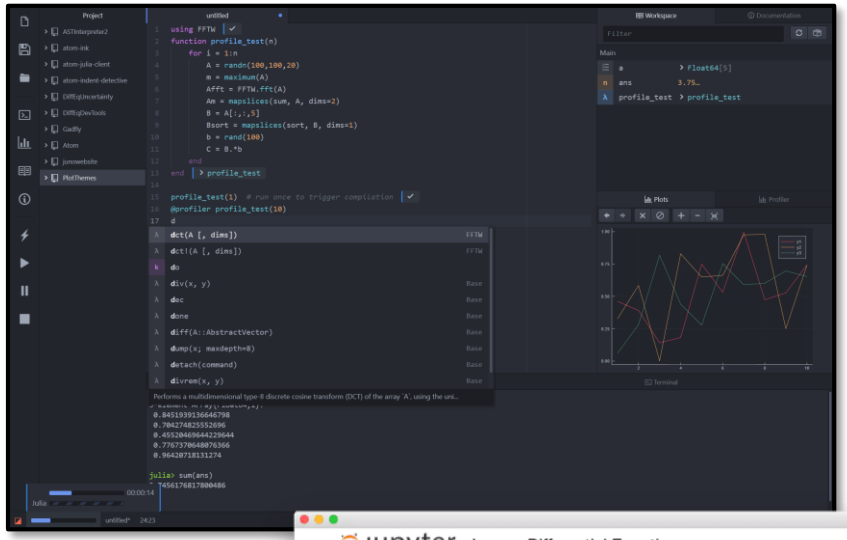

```julia
function babylonian(α; N = 10)
    @assert α > 0 "α must be > 0"
    t = (1+α)/2
    for i = 2:N
        t = (t + α/t)/2
    end
    t
end

babylonian(π) ≈ √π
```

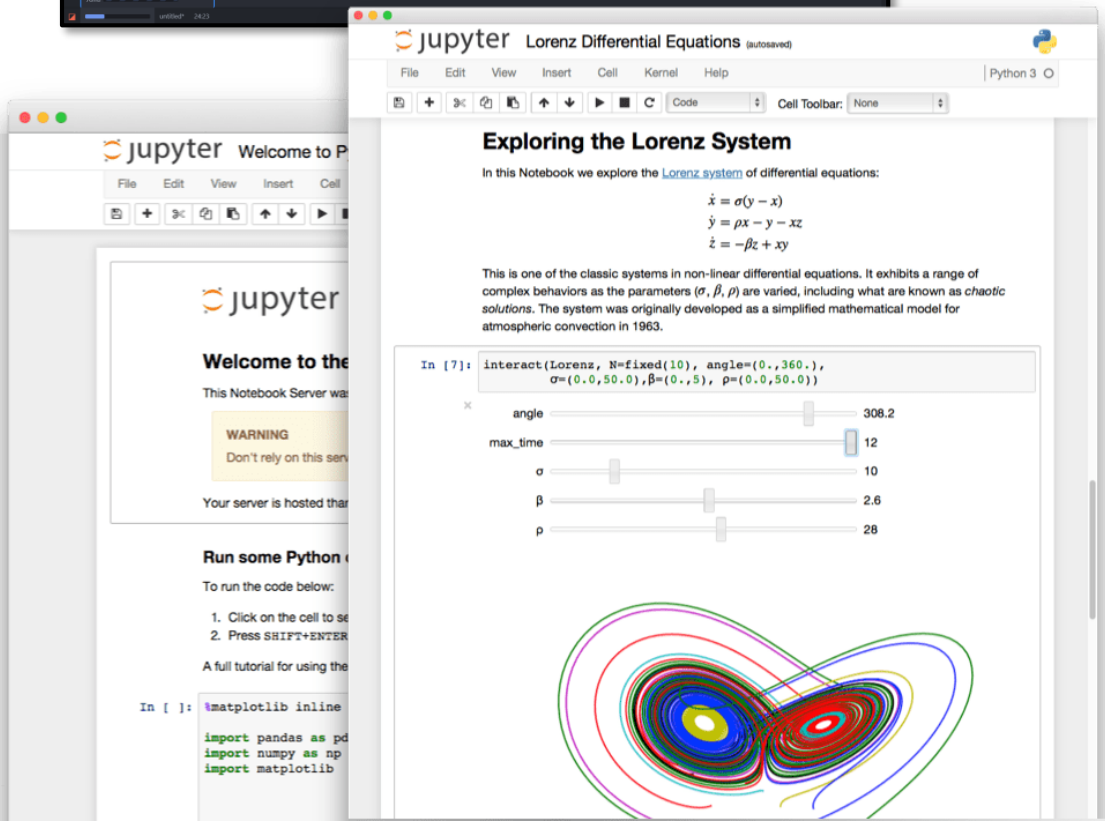
The julia unification

Simple syntax + grammar

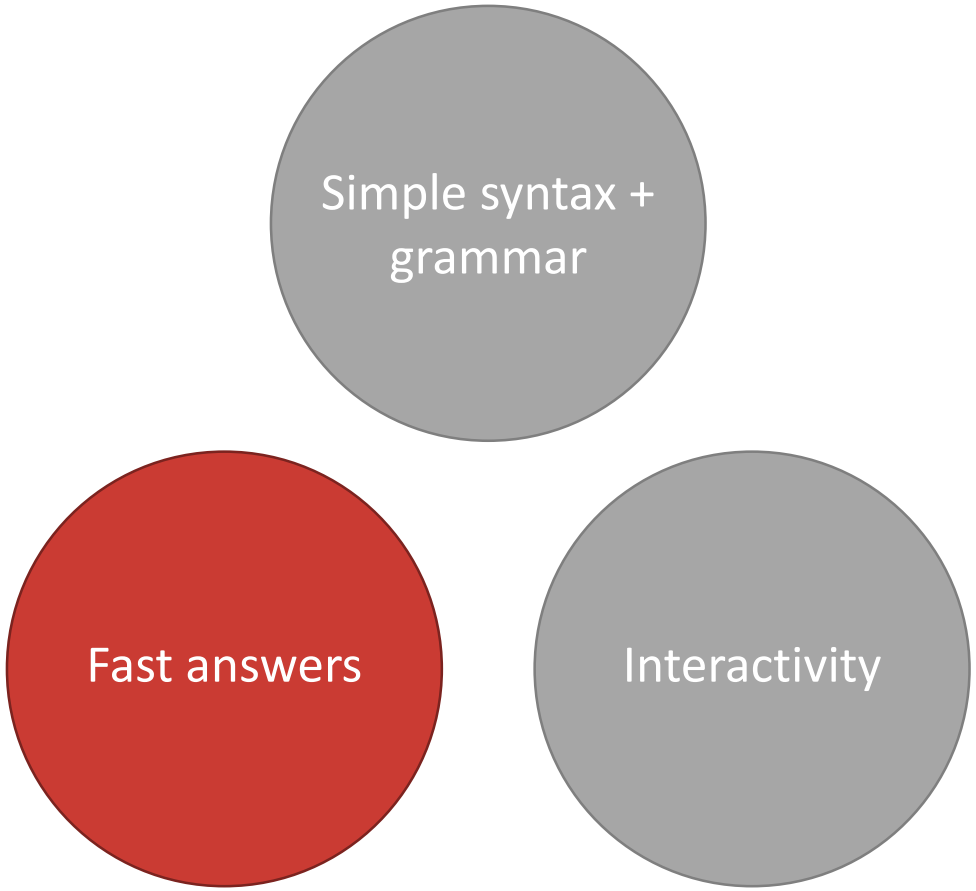
Fast answers

Interactivity





The julia unification




```
julia> function sumup()
           x = 0
           for i in 1:100
               x += i
           end
           x
       end
sumup (generic function with 2 methods)

julia> @code_llvm debuginfo=:none sumup()

; Function Attrs: uwtable
define i64 @julia_sumup_12626() #0 {
top:
  ret i64 5050
}
```

Just returns the answer!
(The for loop was compiled away)

It is free and open source

JuliaLang / julia

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The Julia Language: A fresh approach to technical computing. https://julialang.org/

julia | julia-language | programming-language | scientific-computing | high-performance-computing | numerical-computation | machine-learning

Julia 69.8% | C 15.6% | C++ 9.7% | Scheme 3.3% | Makefile 0.6% | Shell 0.3% | Other 0.7%

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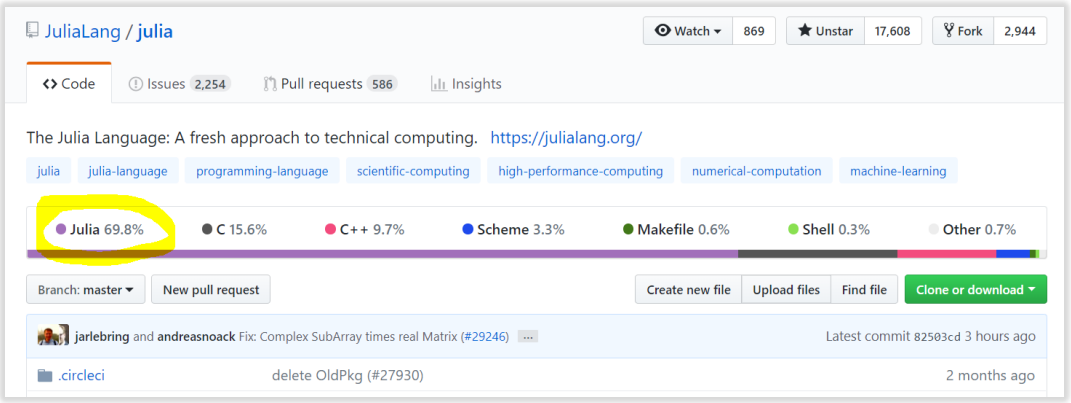
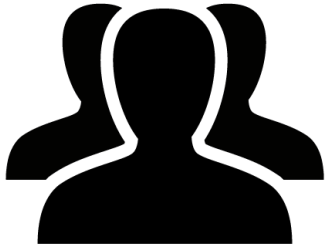
jarlebring and andreasnoack Fix: Complex SubArray times real Matrix (#29246) ... Latest commit 82503cd 3 hours ago

.circleci delete OldPkg (#27930) 2 months ago

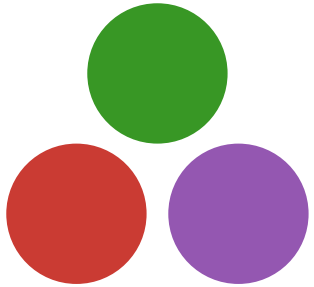
It is inviting



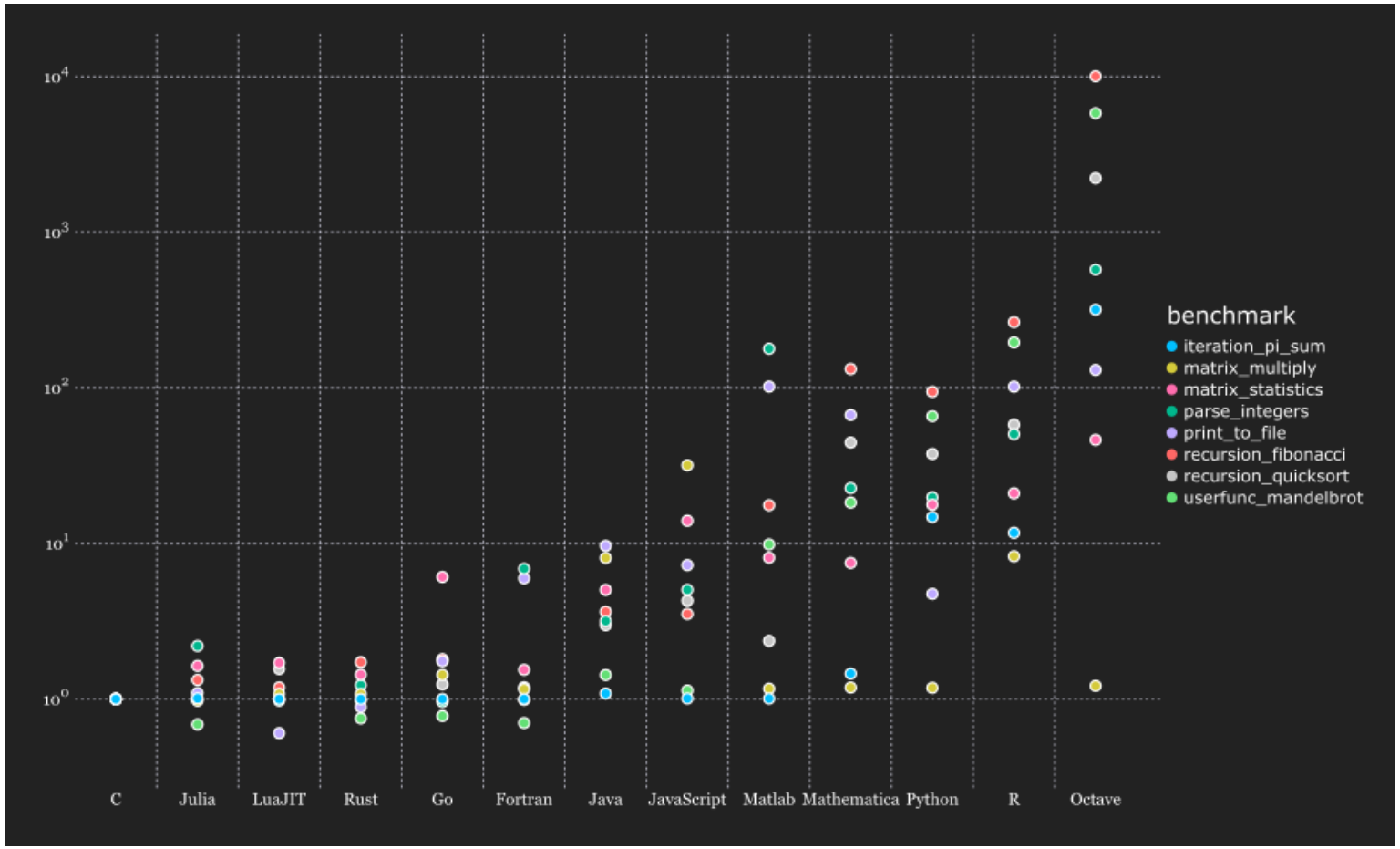
User



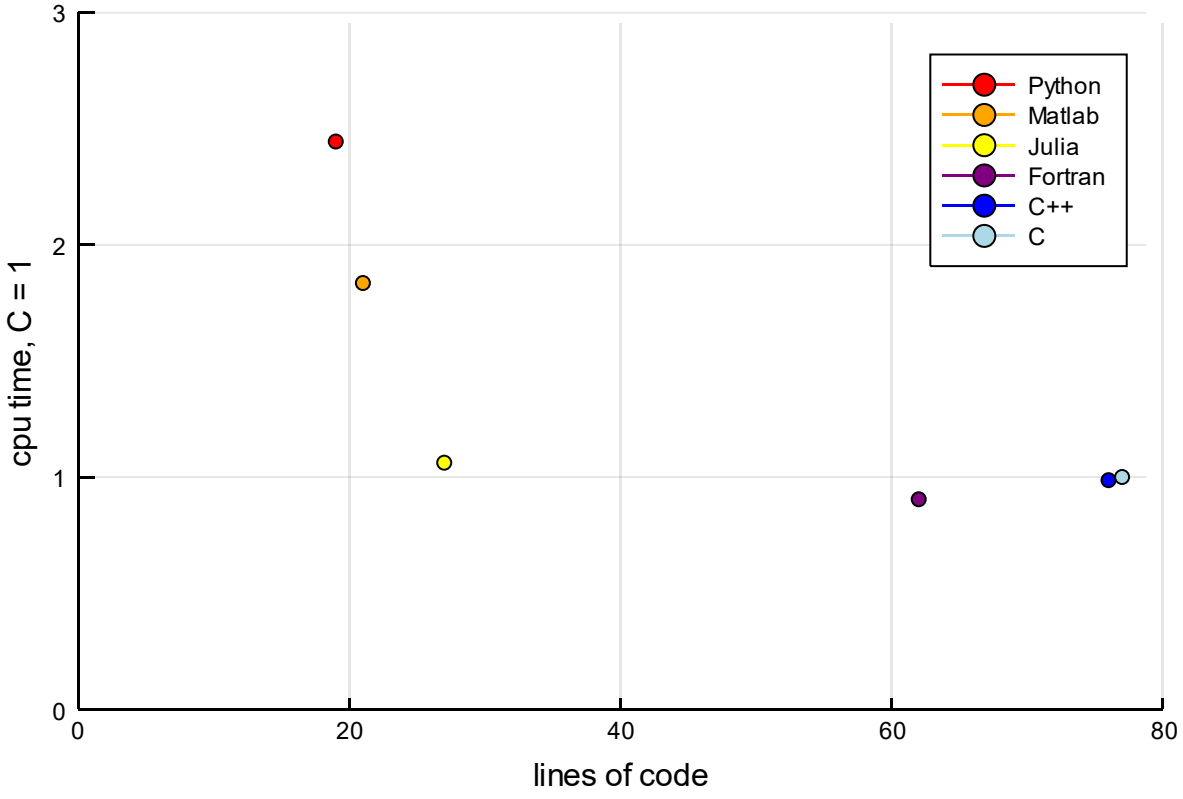
Developer



It is fast


10^4
10^3
10^2
10^1
10^0
C
Julia
LuaJIT
Rust
Go
Fortran
Java
JavaScript
Matlab
Mathematica
Python
R
Octave
benchmark
iteration_pi_sum
matrix_multiply
matrix_statistics
parse_integers
print_to_file
recursion_fibonacci
recursion_quicksort
userfunc_mandelbrot

It is expressive



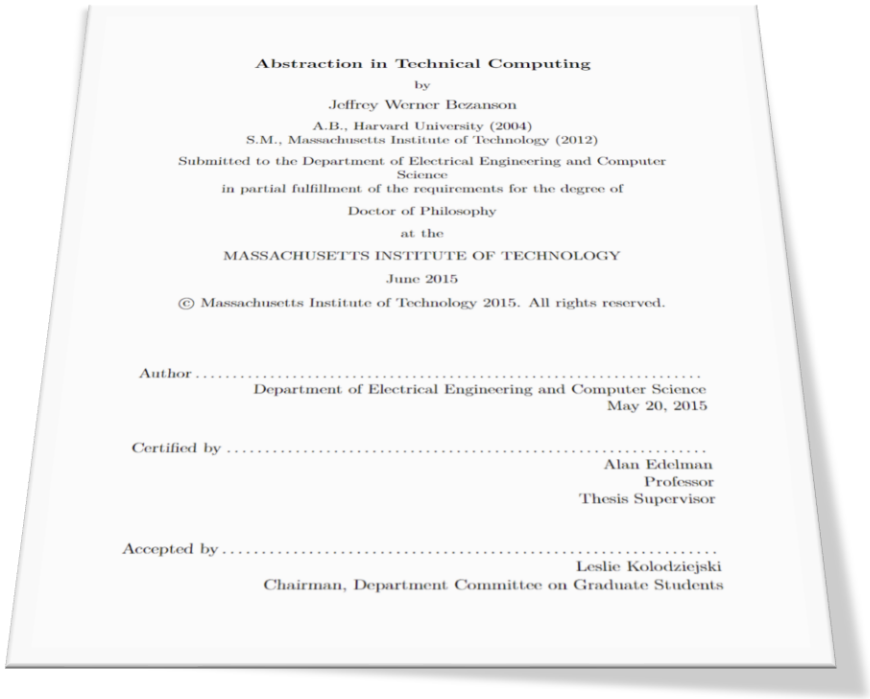
How old is Julia?

2009 Jeff, Stefan, Viral, and Alan start working on Julia

2012 Blog post: [Why we created Julia]

2015 Jeff's PhD & JuliaComputing

2018 Julia 1.0



Abstraction in Technical Computing

by

Jeffrey Werner Bezanson

A.B., Harvard University (2004)
S.M., Massachusetts Institute of Technology (2012)

Submitted to the Department of Electrical Engineering and Computer Science
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2015

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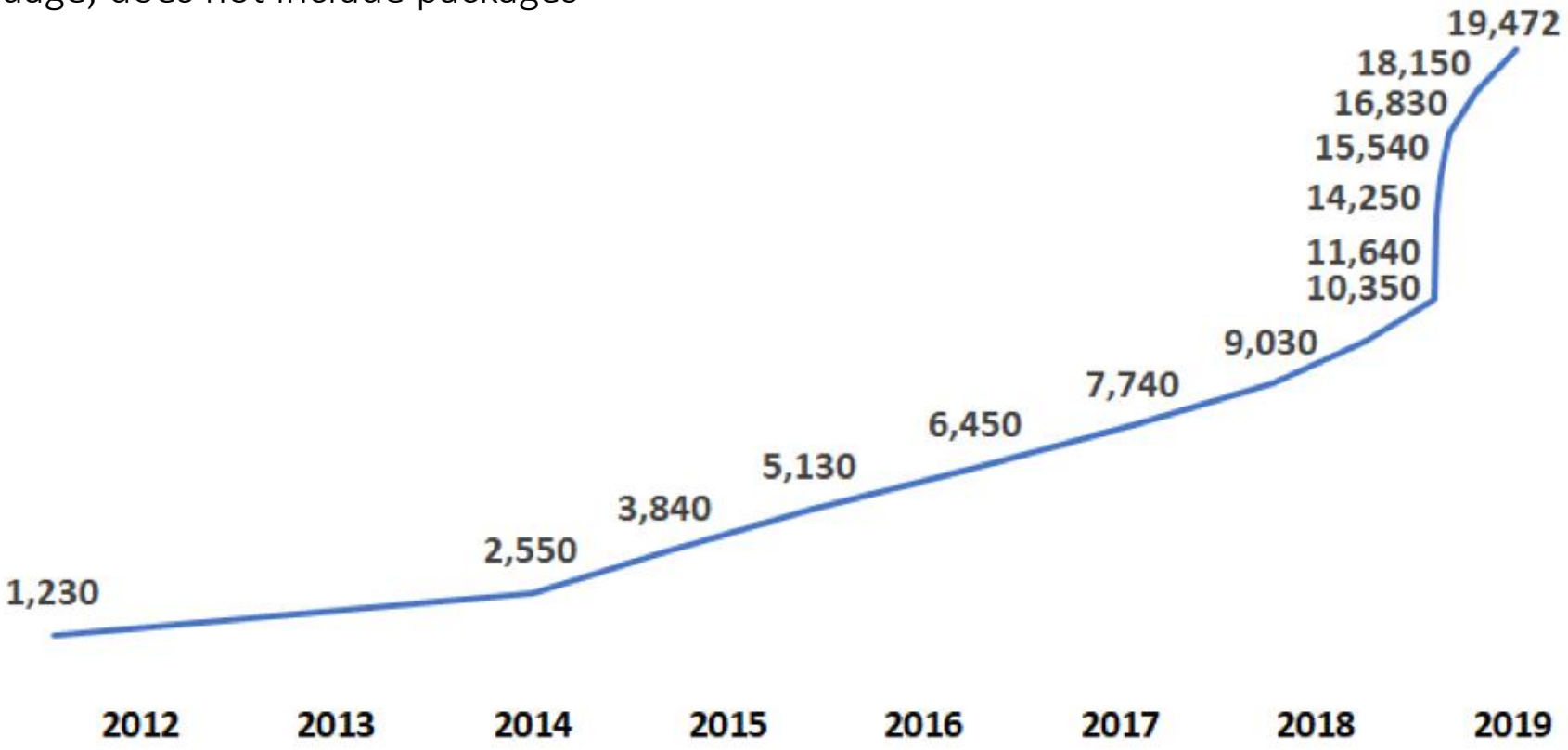
Thesis Supervisor

Accepted by .....
Leslie Kolodziejski
Chairman, Department Committee on Graduate Students

Founders talk @ JuliaCon 2018: https://www.youtube.com/watch?v=1jN5wKvN-Uk

Julia GitHub stars

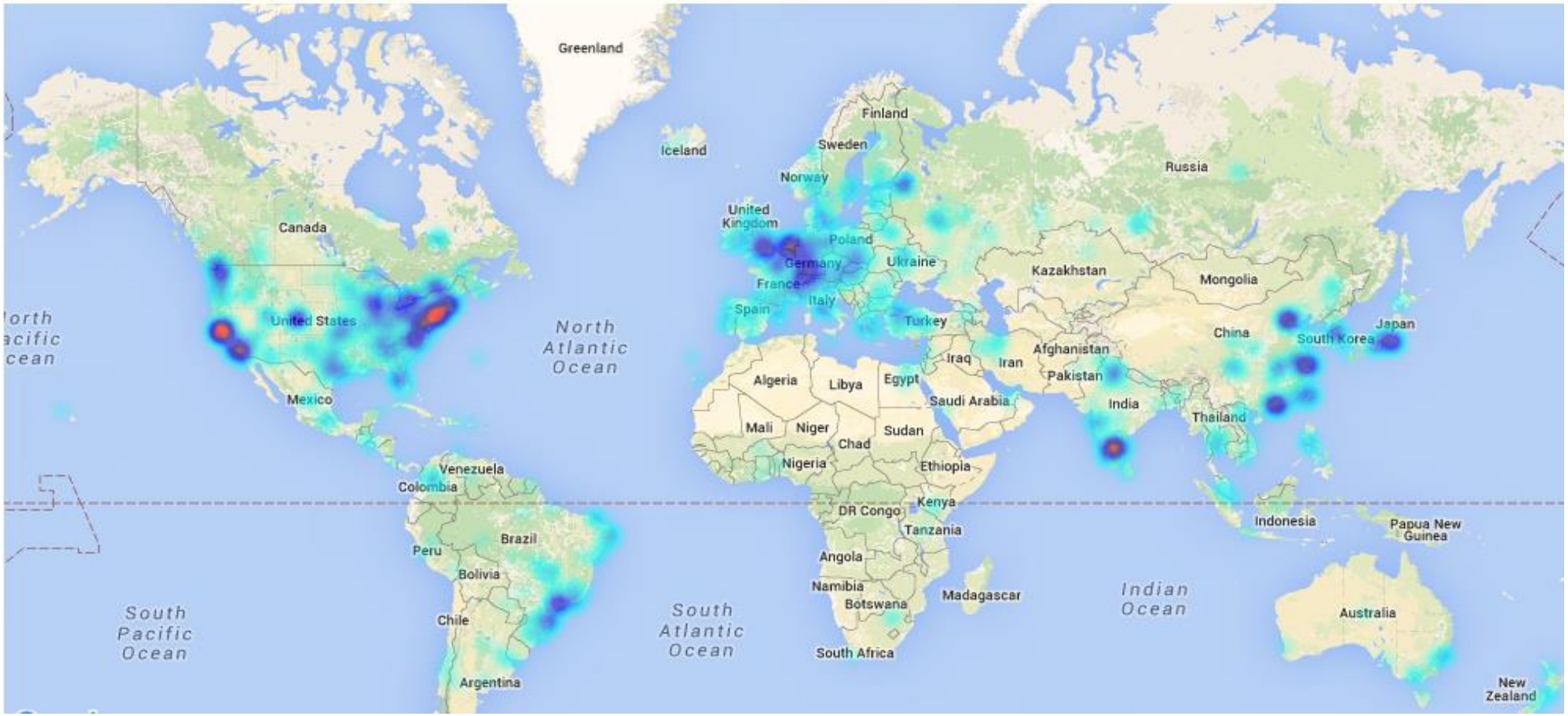
* Base language, does not include packages



https://juliacomputing.com/blog/2019/01/04/january-newsletter.html

A global community

More than 3 Million downloads, 2500 packages



James H. Wilkinson Prize For Numerical Software	Forbes 30 under 30	IEEE Babbage Prize IEEE Fellow
Stefan Karpinski Viral B. Shah Jeff Bezanson (2019)	Keno Fischer (2019)	Prof. Alan Edelman (2018)

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Signal Processing

Computational Biology

Recommended talks

Nick Eubank: What Julia Offers Academic Researchers

George Datseris: Why Julia is the most suitable language for science