Perspective: The State of Julia for Scientific Machine Learning

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Tools and Programming Languages

- Python sucks.

Tools and Programming Languages

- Python’s adoption is in many ways unnatural:

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    - Scripting Language

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- Python’s adoption is in many ways unnatural:
  - Scripting Language
  - Slow
  - Challenging to maintain
  - Poor package management

Tools and Programming Languages

- To Reiterate: Python sucks.

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- **So, why do we use it?**

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- To Reiterate: Python sucks.
- **So, why do we use it?**
- Python is still uber popular
- If you read a paper here, Python was probably used for the research

Tools and Programming Languages

- A lot of this boils down to the

“TWO LANGUAGE PROBLEM”

Tools and Programming Languages

- The two language problem states that a programming language can not be fast and high-level
- Python is high-level, and often wraps around C/C++ for anything that needs to be performant (e.g. Torch)

Tools and Programming Languages

- In Response, Julia was invented to defy the following laws of nature (Bezanson et al.)
  - High-level dynamic programs have to be slow
  - One must prototype in one language and deploy in another
  - Some things should be left for the experts

Tools and Programming Languages

- Julia directly answers the two language problem
  - Fast and High level

JULIA: A FRESH APPROACH TO NUMERICAL COMPUTING 91

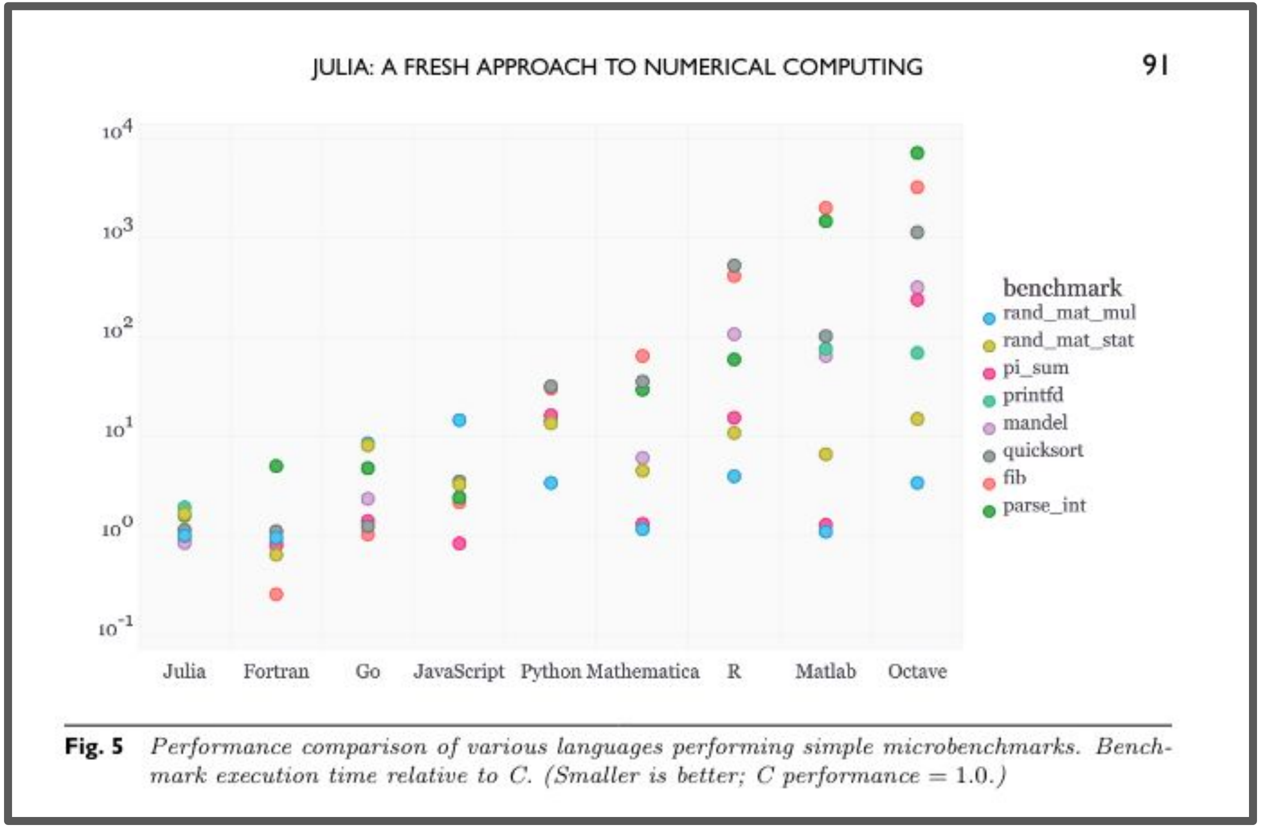

Fig. 5 *Performance comparison of various languages performing simple microbenchmarks. Benchmark execution time relative to C. (Smaller is better; C performance = 1.0.)*

(Bezanson et al.)

Tools and Programming Languages

- High-level
  - Leverages multiple dispatch
  - Functional Paradigm
  - Garbage Collection
  - Optional Type Annotations
  - Clear, thorough style guides

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  - Optional Type Annotations
  - Clear, thorough style guides [e.g. SciML]
    - “Stylish guides for stylish developers” :)

Tools and Programming Languages

- Julia has amazing infrastructure for Scientific Machine Learning
    - SciML, JuMP, Zygote, JuliaDiff, Turing, DifferentialEquations, etc…
    - Great for constrained optimization

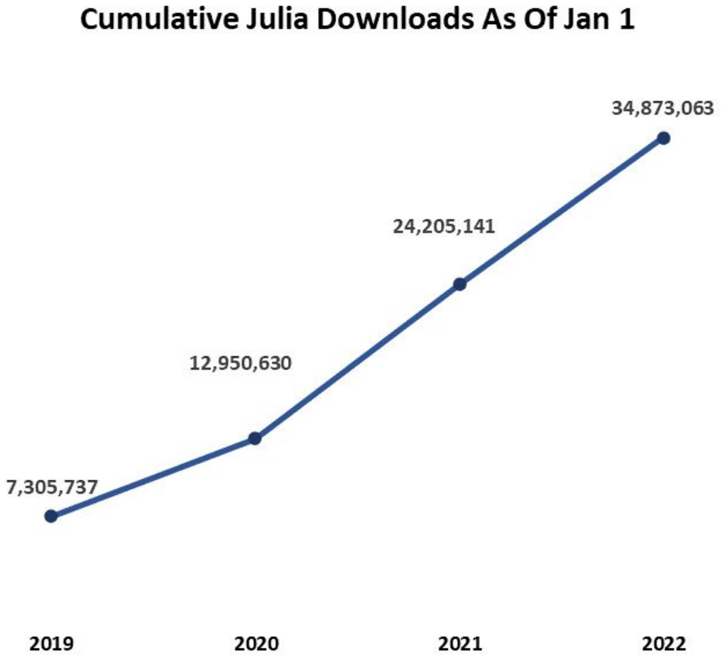
Tools and Programming Languages

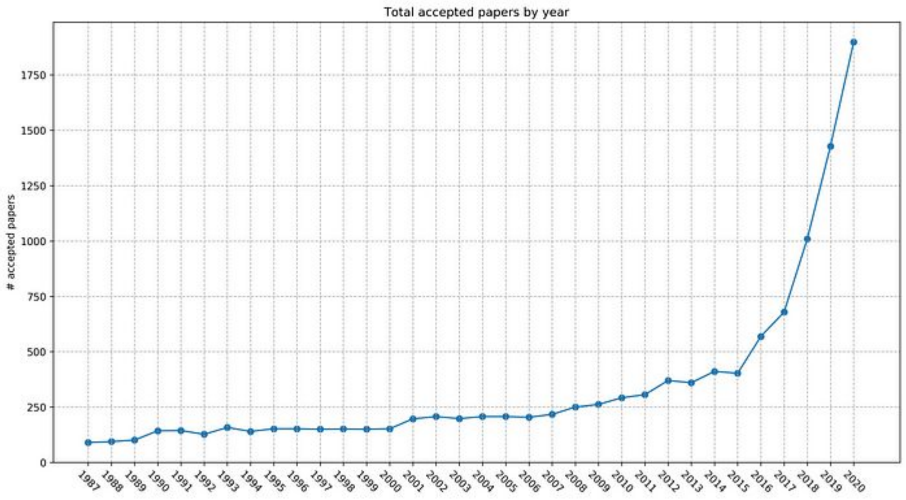
- Julia also has great package management (Pkg)

Tools and Programming Languages

- Julia is… growing?…

Julia Downloads and Accepted NeurIPS papers over time



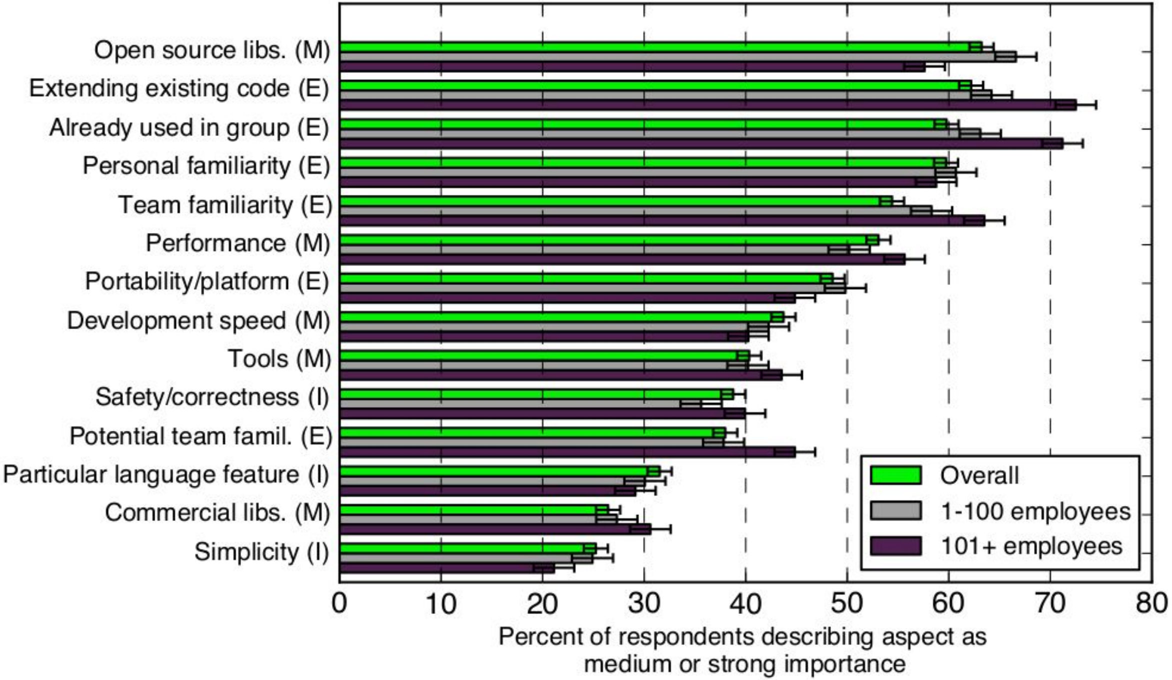


Tools and Programming Languages

- Why is Python still the de-facto language for Scientific Machine Learning Problems? Is the answer really just **momentum?**

Language Adoption

- Clearly momentum plays some role...



[meyerovich et al.]

Language Adoption

- The momentum idea is **incomplete**
- Programming languages like Rust have emerged, despite other languages having similar utility

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- Julia has an amazing ecosystem with stellar performance
- Julia has exquisite support for the sciences in particular
- PyTorch even has a Julia dependency! (PySR -> SymbolicRegressions.jl)
- **Why aren’t people using Julia?**

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    - Industry Support

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    - Strong testing infrastructure and software engineering features
    - Interoperability (especially with C)
    - A good debugger

Language Adoption

- Industry Support (it’s the economy stupid!)
  - Julia doesn’t have nothing (case studies)

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- Julia Hub Survey Data [JuliaCon 2024] finds:
  - 64% respondents said there are not enough Julia users in field or industry
  - 71% use Julia for research, but only 16% for business critical tasks

Language Adoption

- And why doesn’t industry use Julia?

Language Adoption

- And why doesn’t industry use Julia?
- Why is it an academic thing?

Language Adoption

- One Potential Answer is Testing and Engineering Features
- Businesses want their software to be reliable!

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- Most users will be coming from Python or C/C++
- Backwards compatibility is paramount

Language Adoption

- The 2024 JuliaCon survey also identified the **debugger, precompile times, large executables** as problematic

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  - Historical technical debt
  - Not optimized for kernels and small exes like C/C++ [J.B. 2024 Julia Dispatch]

Call to Action

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- We want the best for Julia and the Julia Community
- We think these issues we have raised are currently not being addressed

Call to Action

Try julia !!!

Call to Action

Address Julia’s Language Level Issues

Fin!

- We explored Julia’s readiness for the primetime
- Try Julia. Improve Julia :D

Discourse Thread

https://ebrmn.space/
https://jakegines.in/

Applying to PhD programs!!

</> https://github.com/EdwardBerman/SoJ/tree/main