Introduction to Julia for High-Performance Computing

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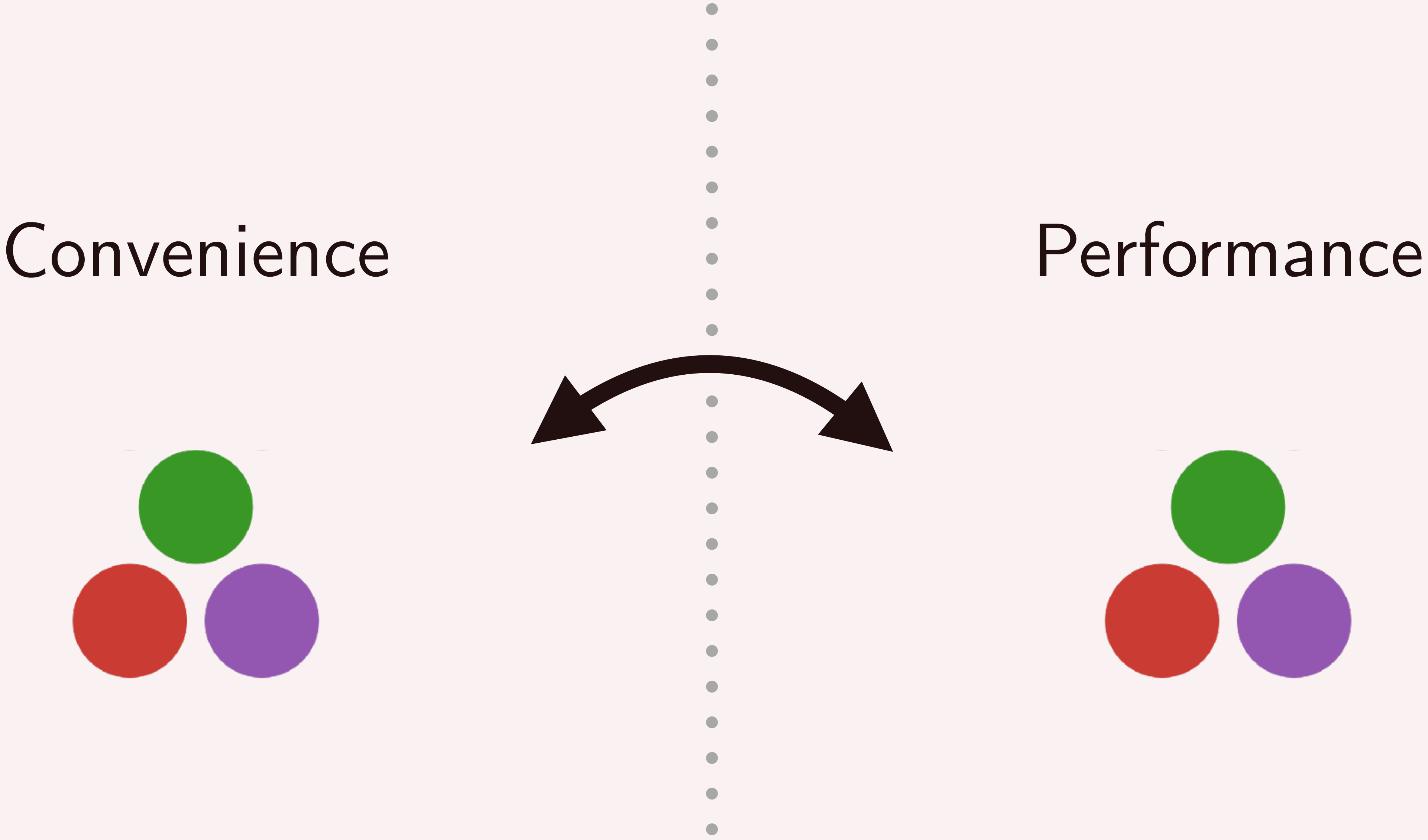
Convenience

Performance

Language Barrier



Convenience

Performance

Gradual transition

	Tuesday	Wednesday	Thursday	Friday
	Foundations	**Core**	**Node**	**Cluster**
09:00 - 10:45	Getting Started	Type & Memory Optimizations	Multithreading	Distributed Computing
10:45 - 11:00	Break	Break	Break	Break
11:00 - 12:30	Fundamentals Exercises	Exercises	Exercises	Exercises
12:30 - 14:00	Lunch	Lunch	Lunch	Lunch
14:00 - 15:30	Compilation	SIMD	GPU Computing	Profiling
15:30 - 15:45	Break	Break	Break	Outro
15:45 - 17:00	Exercises	Exercises	Exercises	

Quick Live Survey

Julia’s Weaknesses

HPC with Julia is currently a niche.

Join us at conferences ...

... or in our monthly Zoom call

(open to everyone!)

Achieving
high performance
can be tricky.

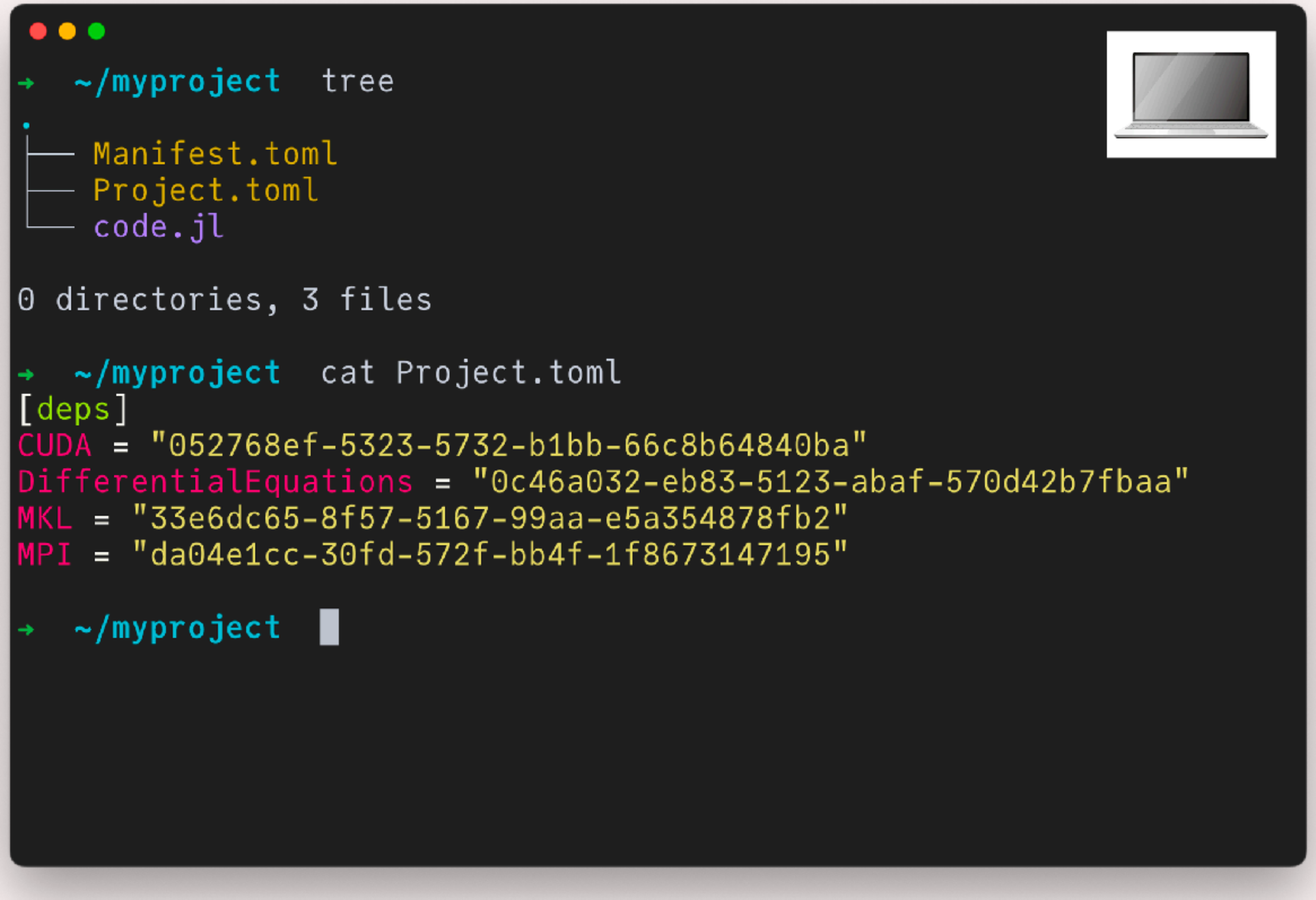
No great way to produce (small) binaries.

Julia’s Strengths

Julia is interactive and convenient.

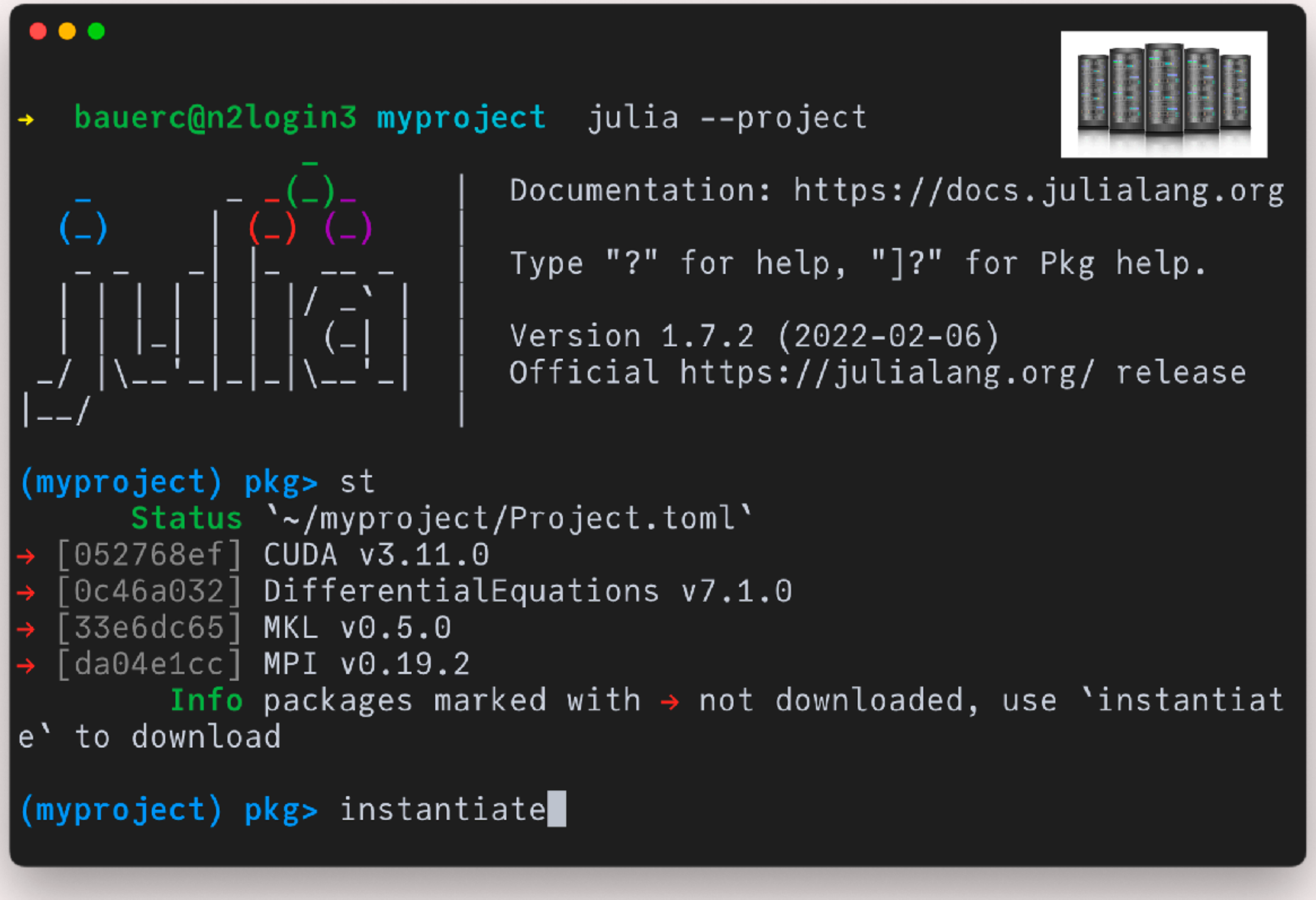
Julia has a great package manager

Laptop



```
→  ~/myproject  tree
.
├── Manifest.toml
├── Project.toml
└── code.jl

0 directories, 3 files

→  ~/myproject  cat Project.toml
[deps]
CUDA = "052768ef-5323-5732-b1bb-66c8b64840ba"
DifferentialEquations = "0c46a032-eb83-5123-abaf-570d42b7fbaa"
MKL = "33e6dc65-8f57-5167-99aa-e5a354878fb2"
MPI = "da04e1cc-30fd-572f-bb4f-1f8673147195"

→  ~/myproject  
```

HPC Cluster

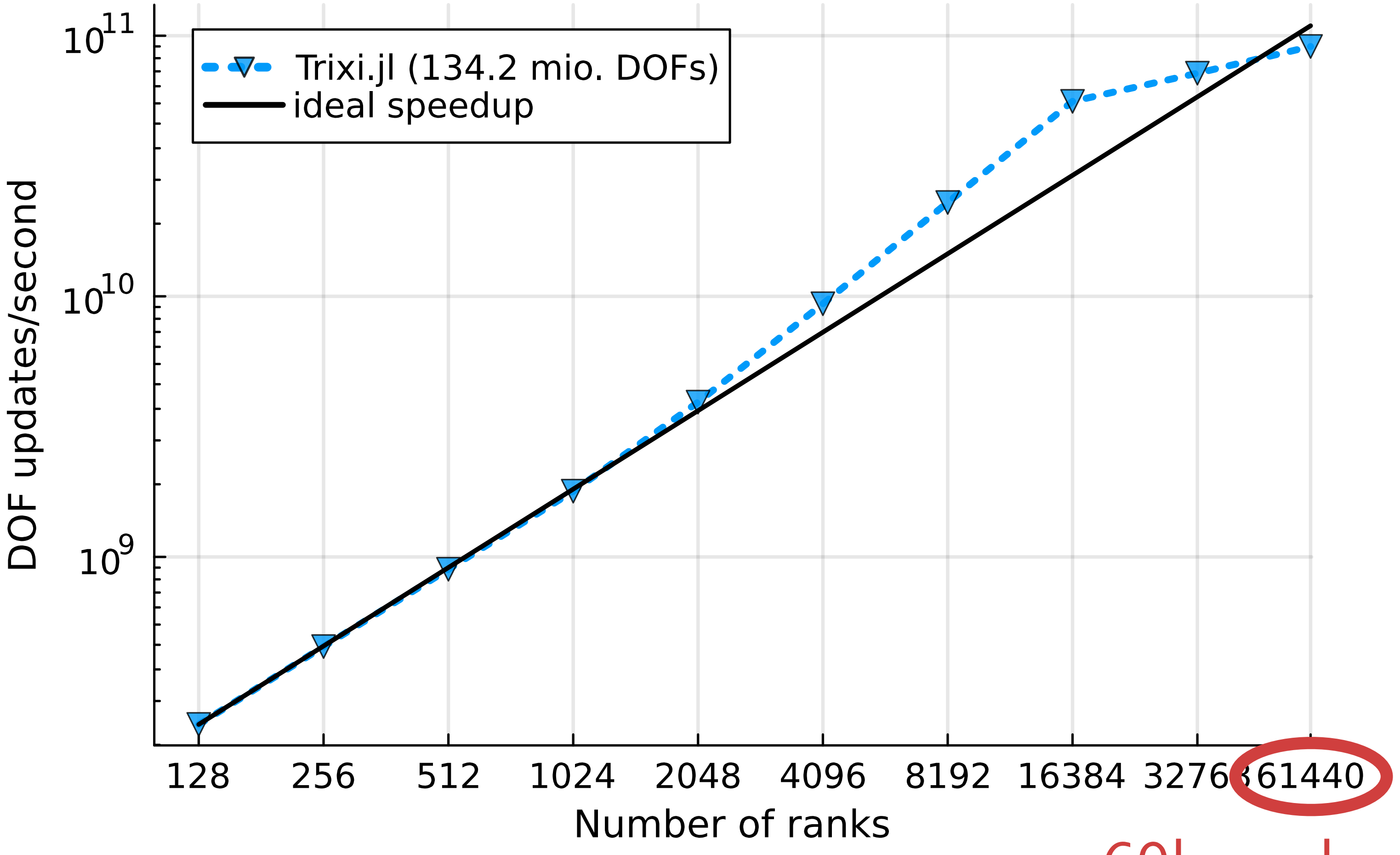


```
→  bauerc@n2login3 myproject  julia --project
               _
   _       _ _(_)_     |  Documentation: https://docs.julialang.org
  (_)     | (_) (_)    |
   _ _   _| |_  __ _   |  Type "?" for help, "]?" for Pkg help.
  | | | | | | |/ _` |  |
  | | |_| | | | (_| |  |  Version 1.7.2 (2022-02-06)
 _/ |\__'_|_|_|\__'_|  |  Official https://julialang.org/ release
|__/                   |

(myproject) pkg> st
      Status `~/myproject/Project.toml`
→ [052768ef] CUDA v3.11.0
→ [0c46a032] DifferentialEquations v7.1.0
→ [33e6dc65] MKL v0.5.0
→ [da04e1cc] MPI v0.19.2
        Info packages marked with → not downloaded, use `instantiat
e` to download

(myproject) pkg> instantiate
```

Julia code can be **fast** and **scalable**.

Example: Good scaling of PDE codes

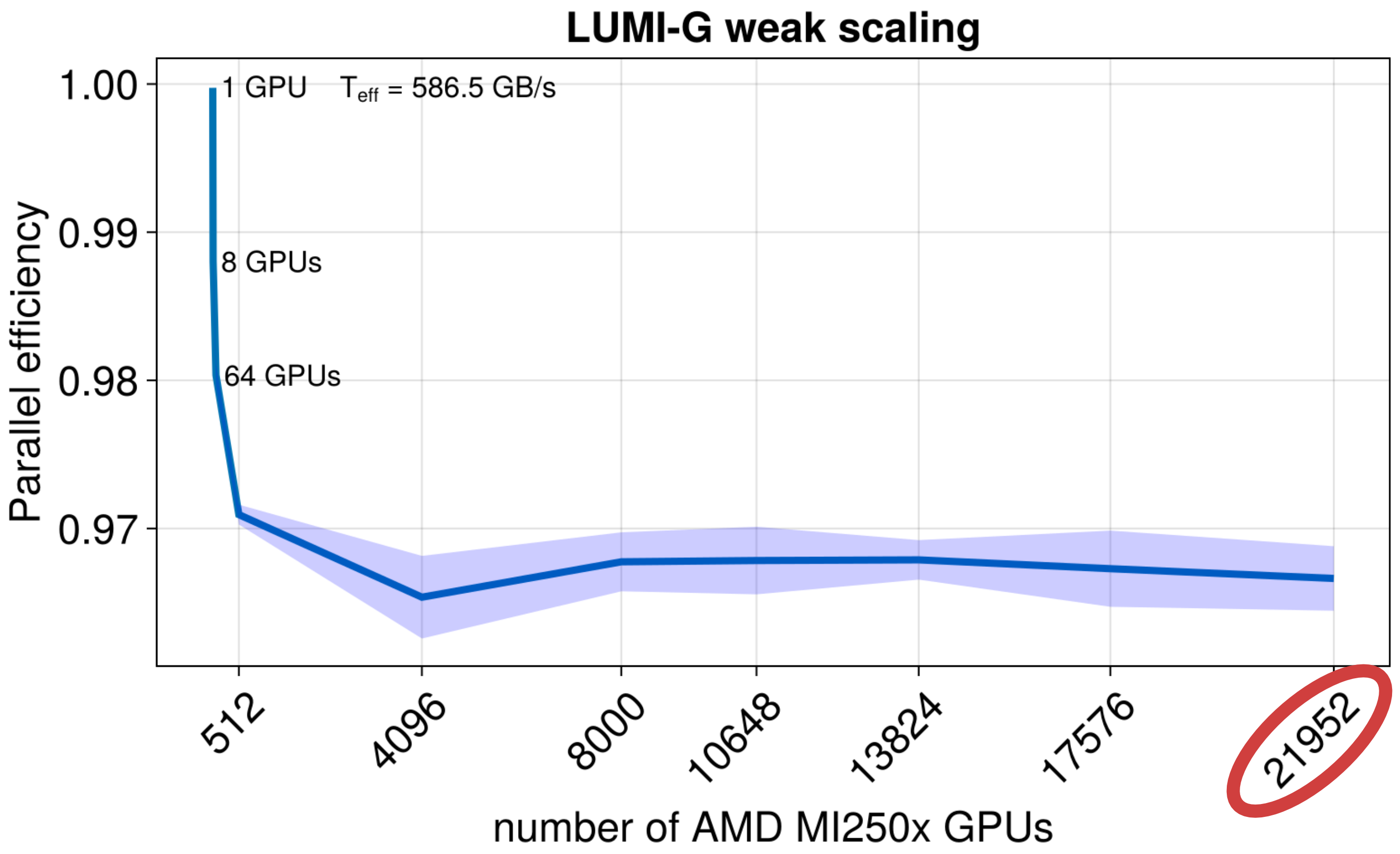
(higher is better)



≈ 60k ranks

Trixi.jl (Multi-CPU)

(higher is better)

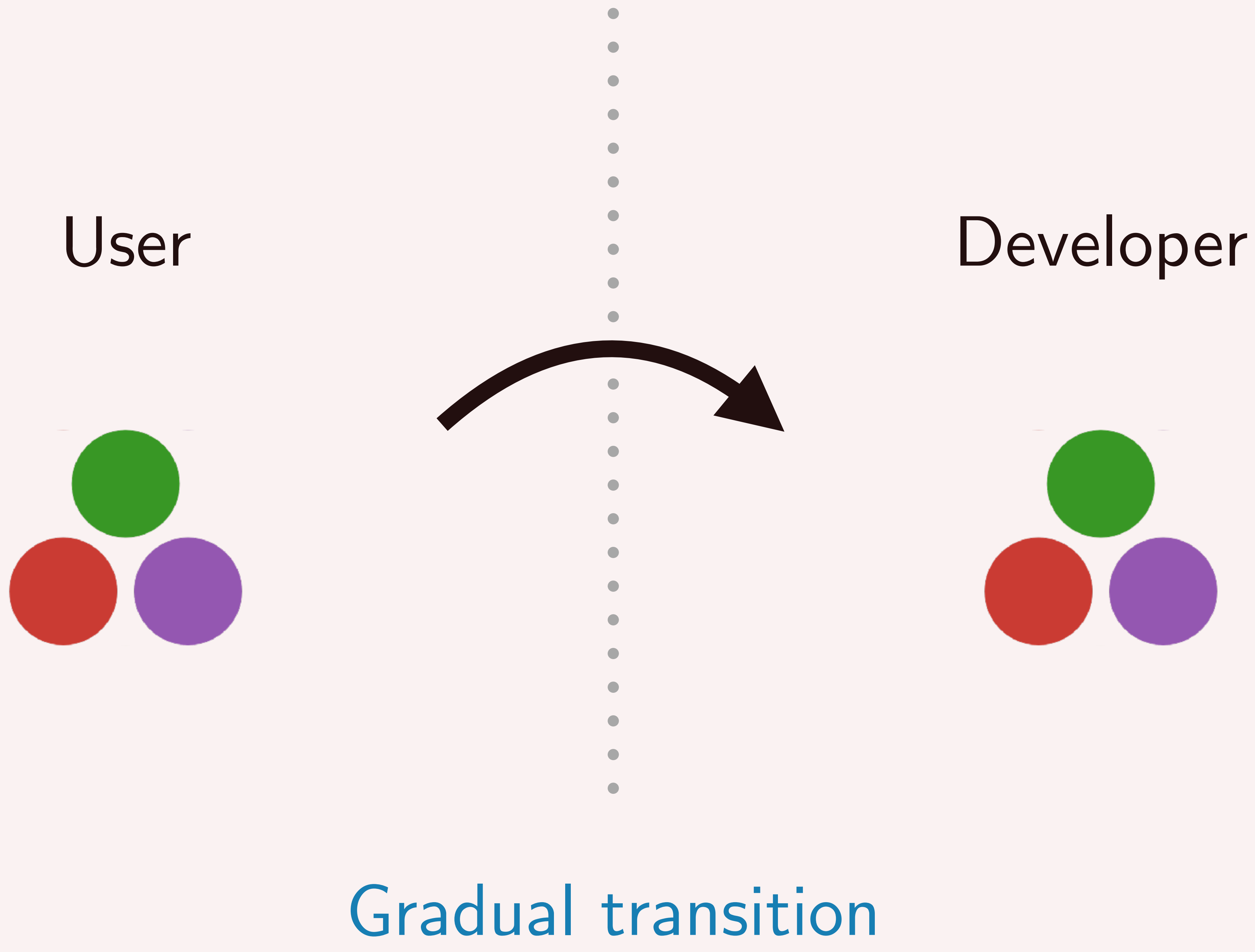


≈ 22k GPUs

ParallelStencil.jl (Multi-GPU)

Julia invites you to gradually delve deeper.

Julia makes it easier to become a developer.



User

Developer

Gradual transition

Let us delve deeper!