Julia

A Guide on Using Julia Language

The language of the future?

Julia or not Julia

Advantages & Disadvantages

1. Not whitespace-sensitive (or indentation-sensitive) xD
2. Parallel computing (and Macros), Multiple Dispatch, etc.
3. Universal! Can be run inside Python, R, C and … and vice versa
4. Has all the goods in one place (From R to Matlab & from Python to C)
5. Much faster than Python (Due to the use of Just In Time (JIT) compiler)
6. Solves the two-language problem: You can prototype & put into production the same source code
7. Package development is way easier & usually 100% written in Julia rather than C/C++ & Python combination
8. Smaller community, tutorials and sample codes
9. Harder to debug as it doesn't point you exactly to the problem like Python (See packages slides for a remedy)
10. Less packages (Maybe enough for other tasks than ML & DS. Also, can still use Python/R packages with PyCall/RCall)

Some Stuff to Know

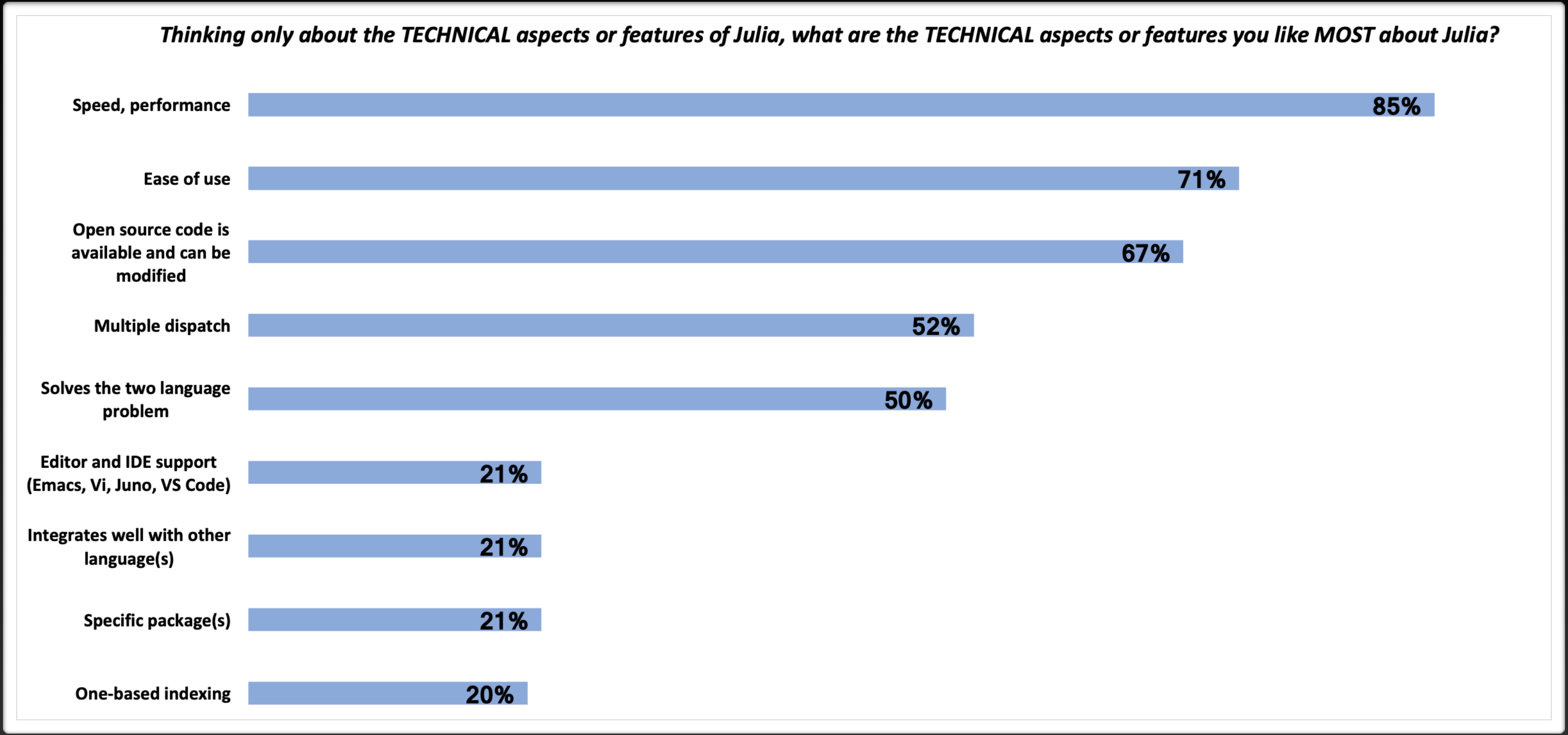
1. In Julia you can use *mathematical symbols* like Σ to name variables in contrast to Python. (Σx = 200 vs. sum_x = 200)
2. It was created with the ambition of combining the *speed* of C, *usability* of Python, the *dynamism* of Ruby, the *mathematical power* of MatLab, and the *statistical power* of R
3. Julia's type system is dynamic, yet takes advantages of static type systems by making it possible to indicate that certain values are of specific types. This allows for example, ***method dispatch*** on the types of function arguments to be deeply integrated with the language

JIT

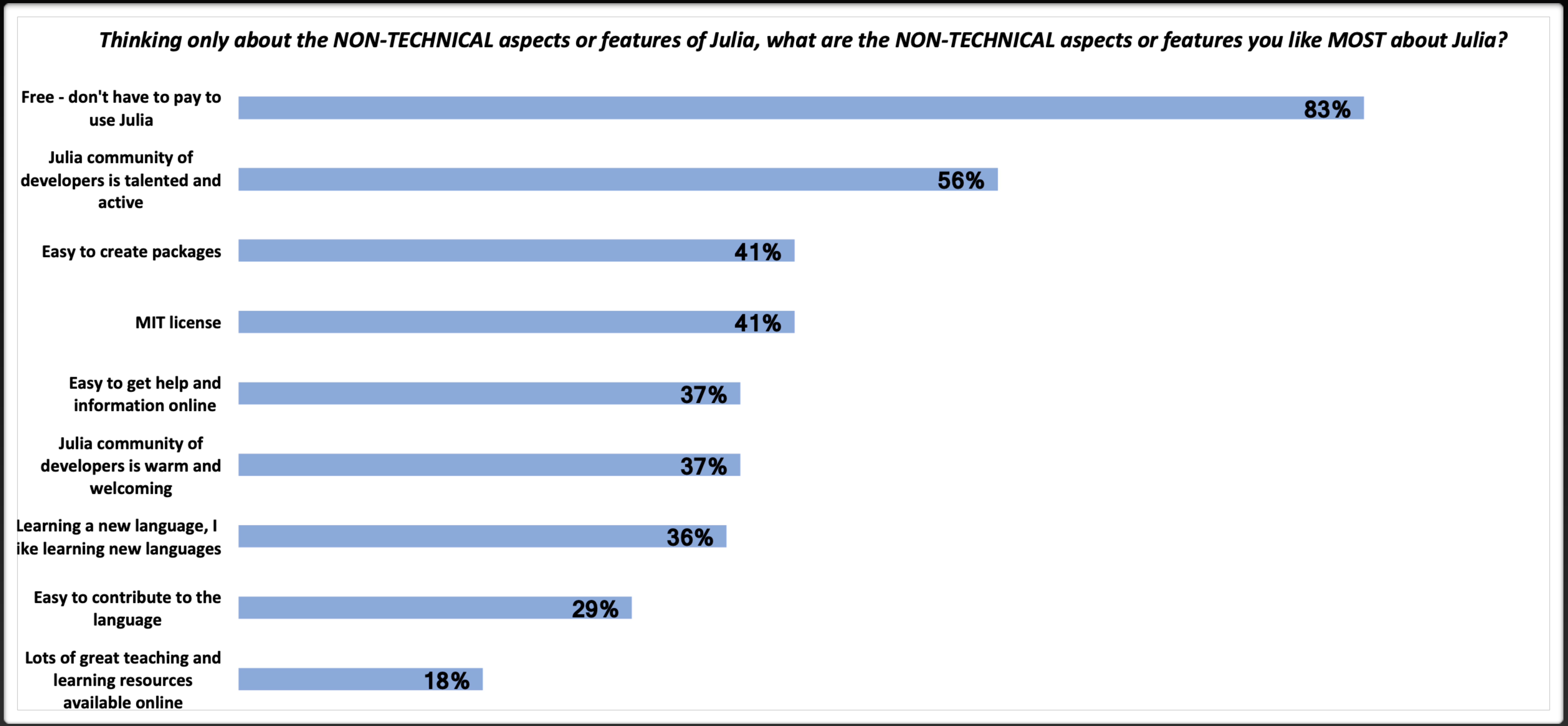
1. Compilation during execution of a program (at run time), in contrast to most compiled languages that compile byte code to machine code before execution.
2. After the first run (compilation), every other call to the same source code is faster than the first call as it can be observed in the example below:

```
add(20.0, 40.0) => 0.003329 seconds (157 allocations: 10.153 KiB)
add(130.0, 120.0) => 0.000004 seconds (5 allocations: 176 bytes)
```

As it is shown above, after the first call with two integers, every other call with any integers will be much faster less memory consuming!



User & Developer Survey 2019, from Julia Computing, Inc.



Thinking only about the NON-TECHNICAL aspects or features of Julia, what are the NON-TECHNICAL aspects or features you like MOST about Julia?

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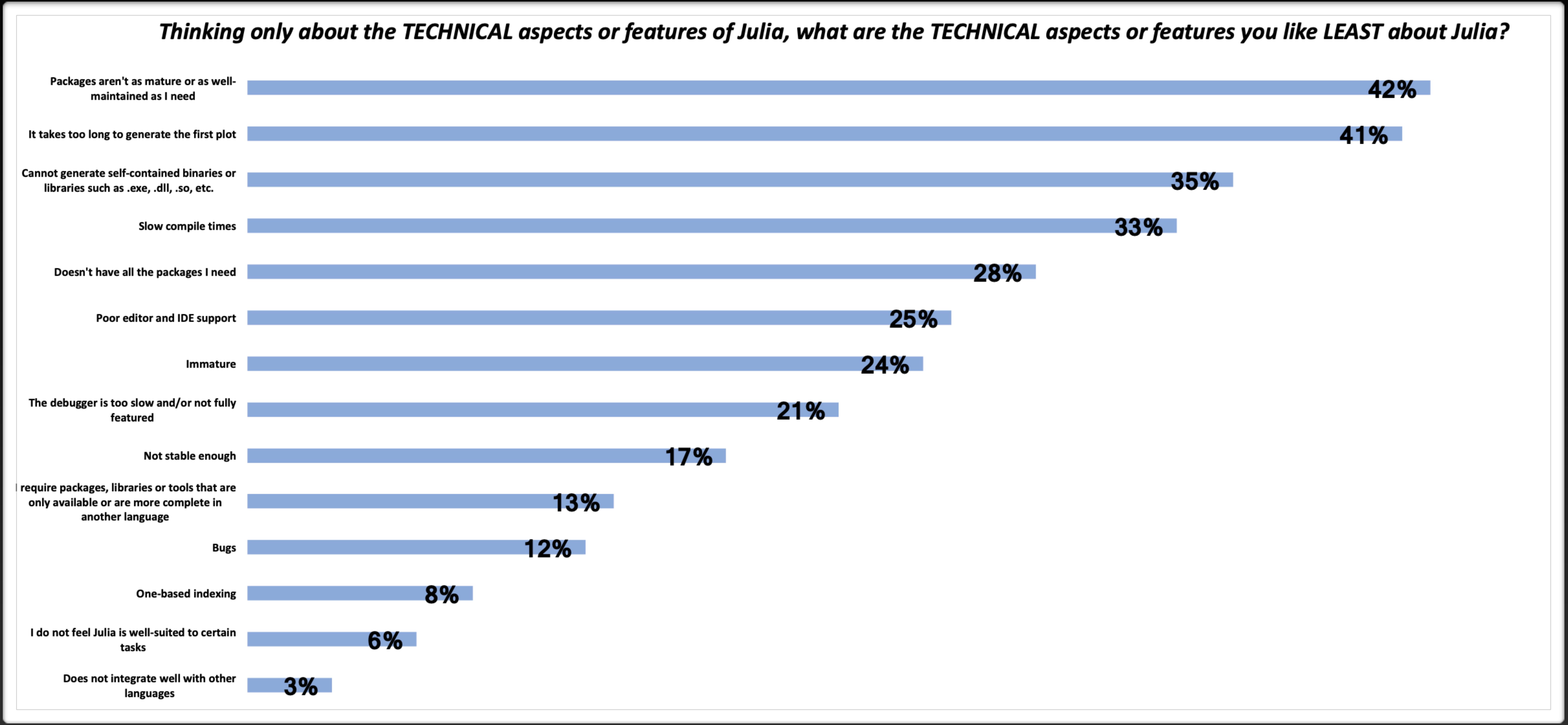

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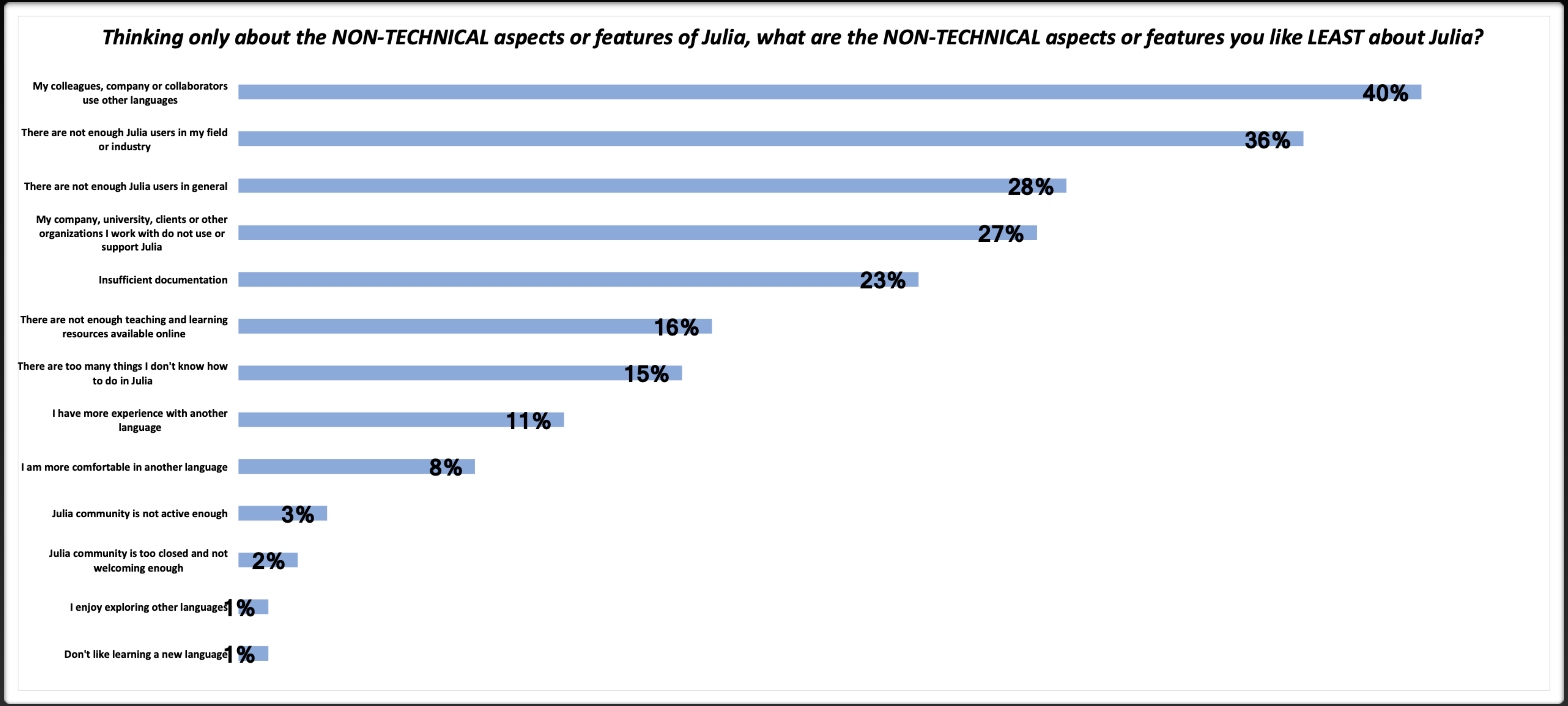


Thinking only about the NON-TECHNICAL aspects or features of Julia, what are the NON-TECHNICAL aspects or features you like LEAST about Julia?

User & Developer Survey 2019, from Julia Computing, Inc.

Installing Julia

Ways to Install

- Using terminal/installer package
- Using Docker
- Using JuliaPro

Installing with Terminal/Package Installer

Windows: 32-bit - 64-bit (Guide)

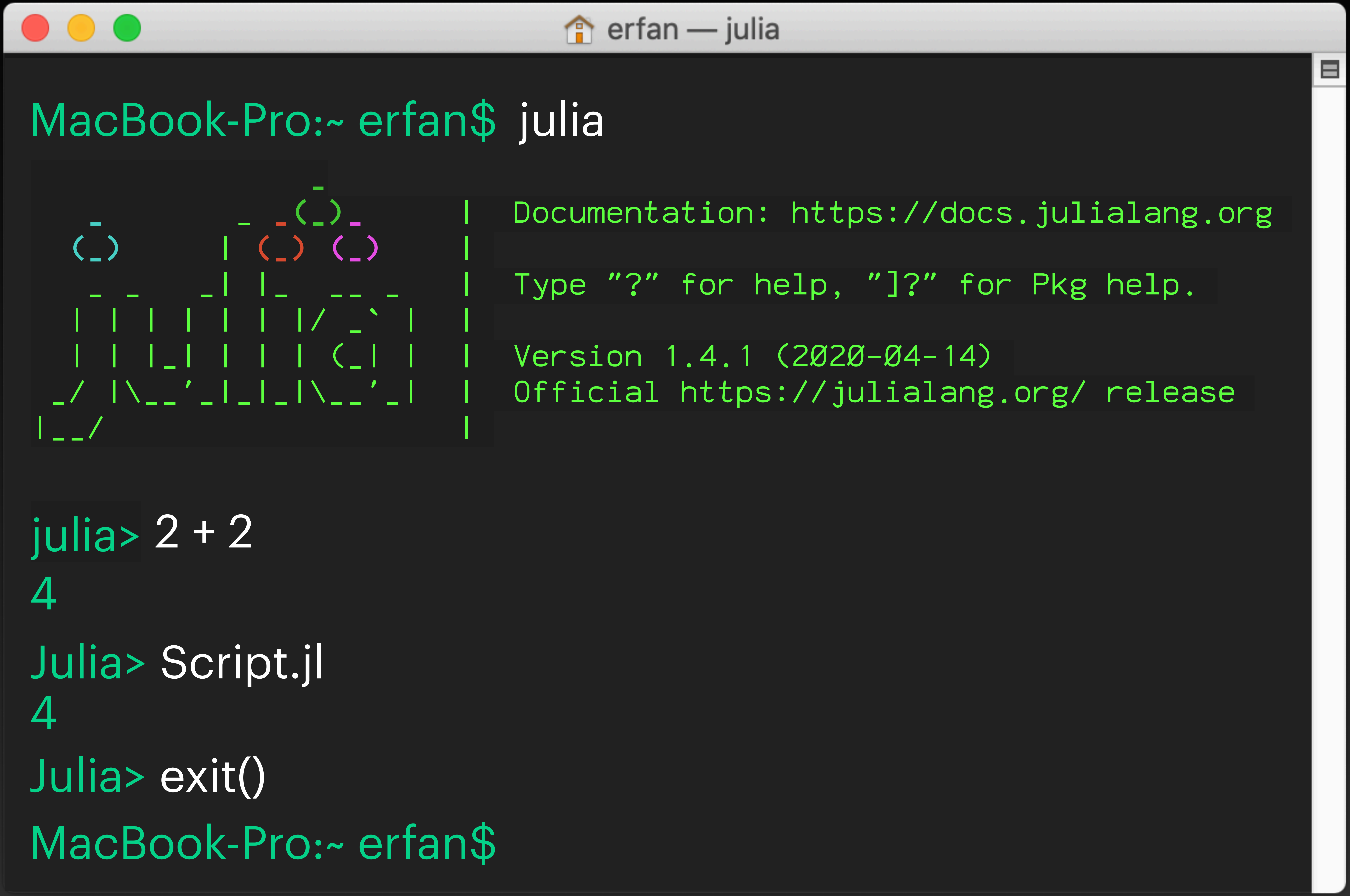
MacOS: 64-bit

Linux: 32-bit - 64-bit

Juno IDE: Download

VSCode Plugin for Julia: Download

PyCharm Plugin for Julia: Download



```
MacBook-Pro:~ erfan$ julia
               _
   _       _ _(_)_     |  Documentation: https://docs.julialang.org
  (_)     | (_) (_)    |
   _ _   _| |_  __ _   |  Type "?" for help, "]?" for Pkg help.
  | | | | | | |/ _` |  |
  | | |_| | | | (_| |  |  Version 1.4.1 (2020-04-14)
 _/ |\__'_|_|_|\__'_|  |  Official https://julialang.org/ release
|__/                   |

julia> 2 + 2
4
Julia> Script.jl
4
Julia> exit()
MacBook-Pro:~ erfan$
```

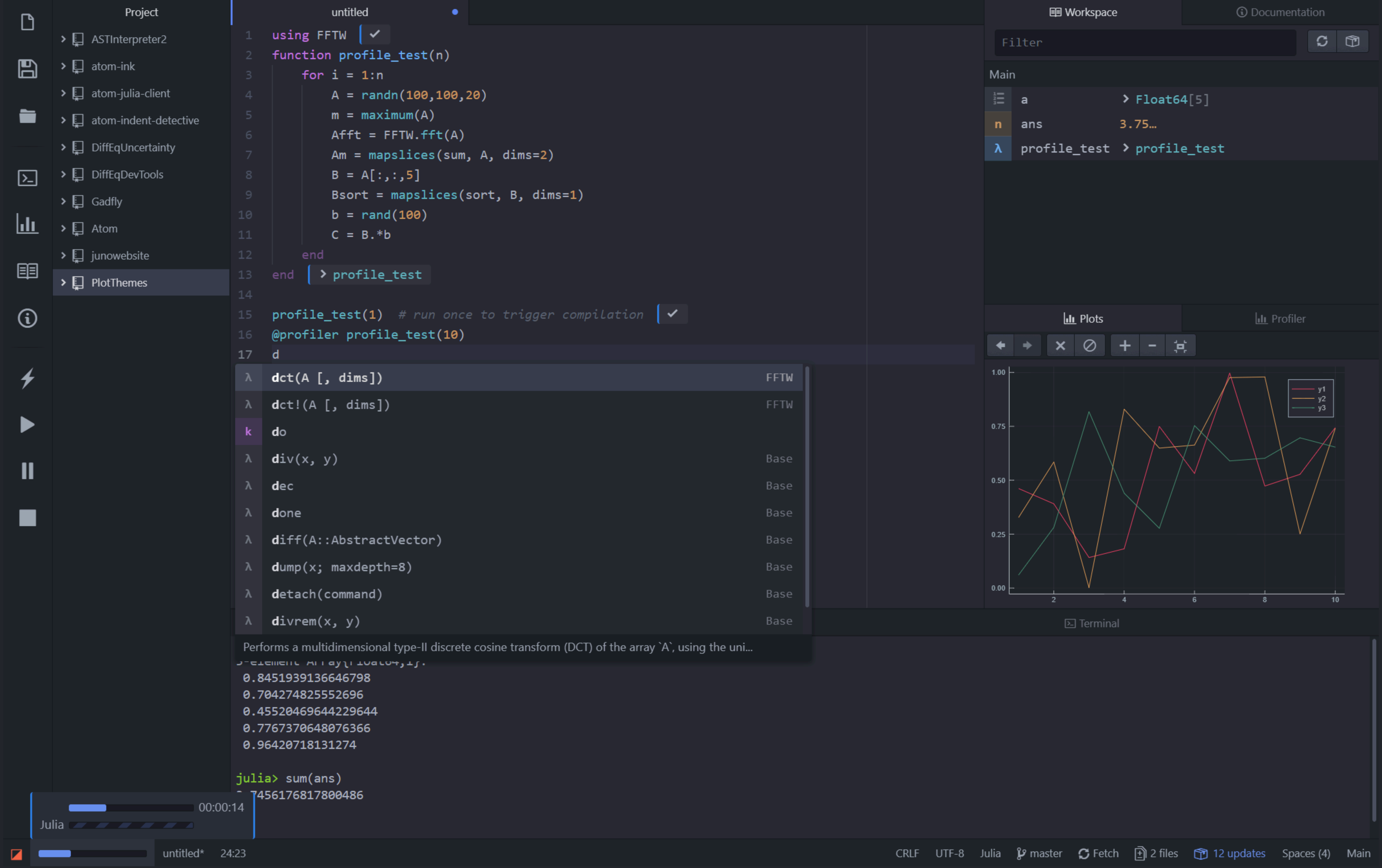
Installing with JuliaPro

JuliaPro is lightweight, easy to install, comes with many packages, and includes tools like plotting, notebook, etc.

Windows: Download

MacOS: Download

Linux: Download



```julia
using FFTW ✓
function profile_test(n)
    for i = 1:n
        A = randn(100,100,20)
        m = maximum(A)
        Afft = FFTW.fft(A)
        Am = mapslices(sum, A, dims=2)
        B = A[:,:,5]
        Bsort = mapslices(sort, B, dims=1)
        b = rand(100)
        C = B.*b
    end
end  > profile_test

profile_test(1)  # run once to trigger compilation  ✓
@profiler profile_test(10)
d
```

```
λ  dct(A [, dims])             FFTW
λ  dct!(A [, dims])            FFTW
k  do
λ  div(x, y)                   Base
λ  dec                         Base
λ  done                        Base
λ  diff(A::AbstractVector)     Base
λ  dump(x; maxdepth=8)         Base
λ  detach(command)             Base
λ  divrem(x, y)                Base
Performs a multidimensional type-II discrete cosine transform (DCT) of the array `A`, using the uni...
```

```
a             > Float64[5]
n  ans          3.75…
λ  profile_test > profile_test
```

```
5-element Array{Float64,1}:
 0.8451939136646798
 0.704274825552696
 0.45520469644229644
 0.7767370648076366
 0.96420718131274

julia> sum(ans)
3.7456176817800486
```

General Programming

DataStructures

LightGraphs

Atom

JuliaWebAPI

IJulia

Nettle

DSP

NearestNeighbors

Parameters

ParserCombinator

Libz

BenchmarkTools

Rebugger

Debugger

General Math

Calculus

DataFrames

StatsBase

Distributions

HypothesisTests

GLM

OnlineStats

DifferentialEquations

SymPy

KernelDensity

Zygote

Optimization

Optim

Roots

Databases

JDBC

Building UIs and Visualization

PyPlot

Interact

LaTeXStrings

Formatting

Images

Plots

GR

UnicodePlots

ImageMagick

StatPlots

PGFPlots

Deep Learning and Machine Learning

Knet

Clustering

DecisionTree

MLBase

Flux

TensorFlow

Metalhead

ScikitLearn

Interoperability with Other Languages

RCall (Interoperability with R)

JavaCall (Java)

PyCall (Python)

Conda (Python dependencies)

JuliaInXL (Microsoft Excel)

File and Data Formats

JSON

JLD2

CSV

LightXML

StaticArrays

ProtoBuf

CuArrays

Economics and Finance

QuantEcon

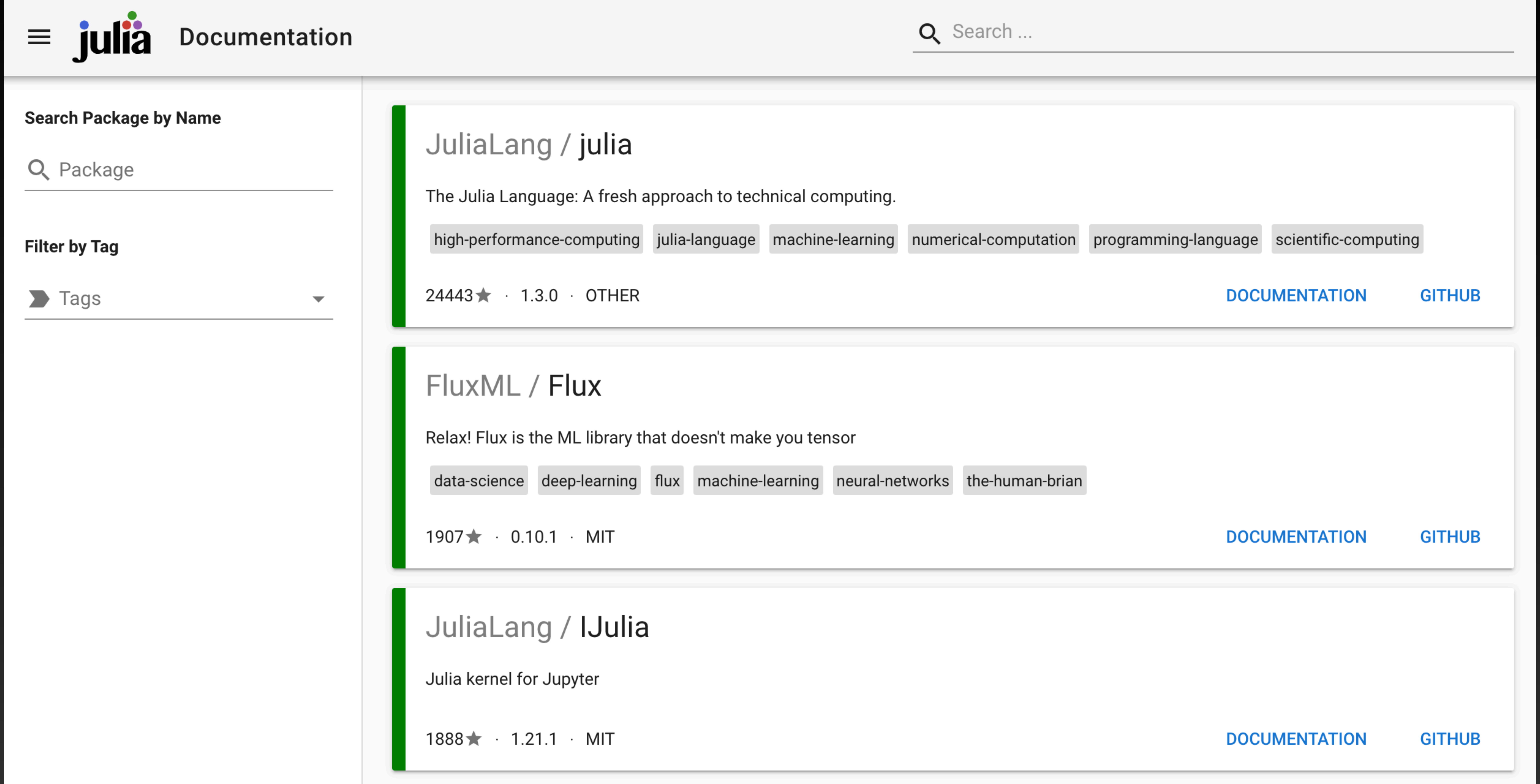
BusinessDays

Bloomberg

Blpapi (Bloomberg connector)

Miletus

Finding Packages



JuliaLang / julia

The Julia Language: A fresh approach to technical computing.

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

24443★ · 1.3.0 · OTHER

FluxML / Flux

Relax! Flux is the ML library that doesn't make you tensor

data-science deep-learning flux machine-learning neural-networks the-human-brian

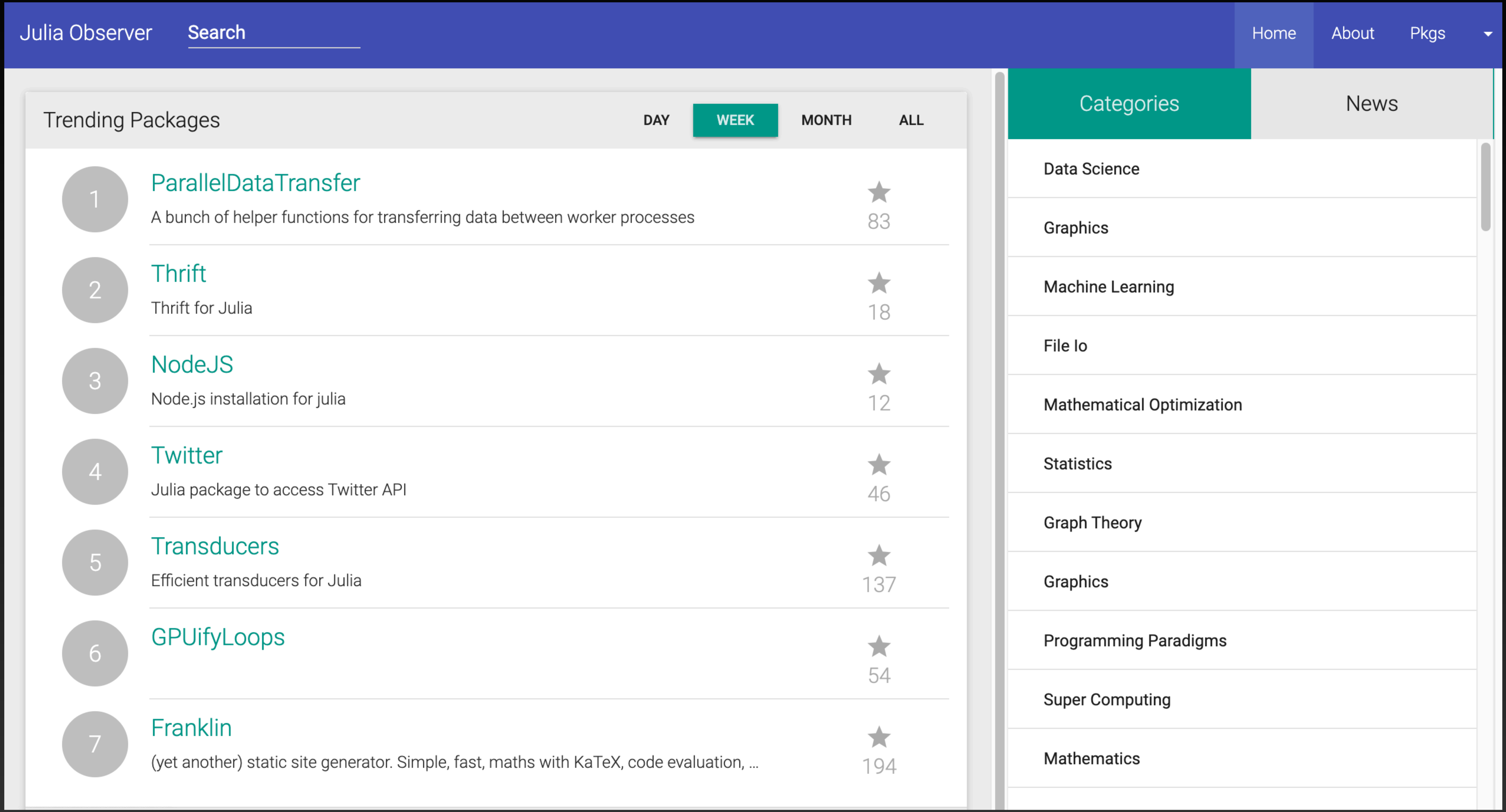
1907★ · 0.10.1 · MIT

JuliaLang / IJulia

Julia kernel for Jupyter

1888★ · 1.21.1 · MIT

Julia Packages

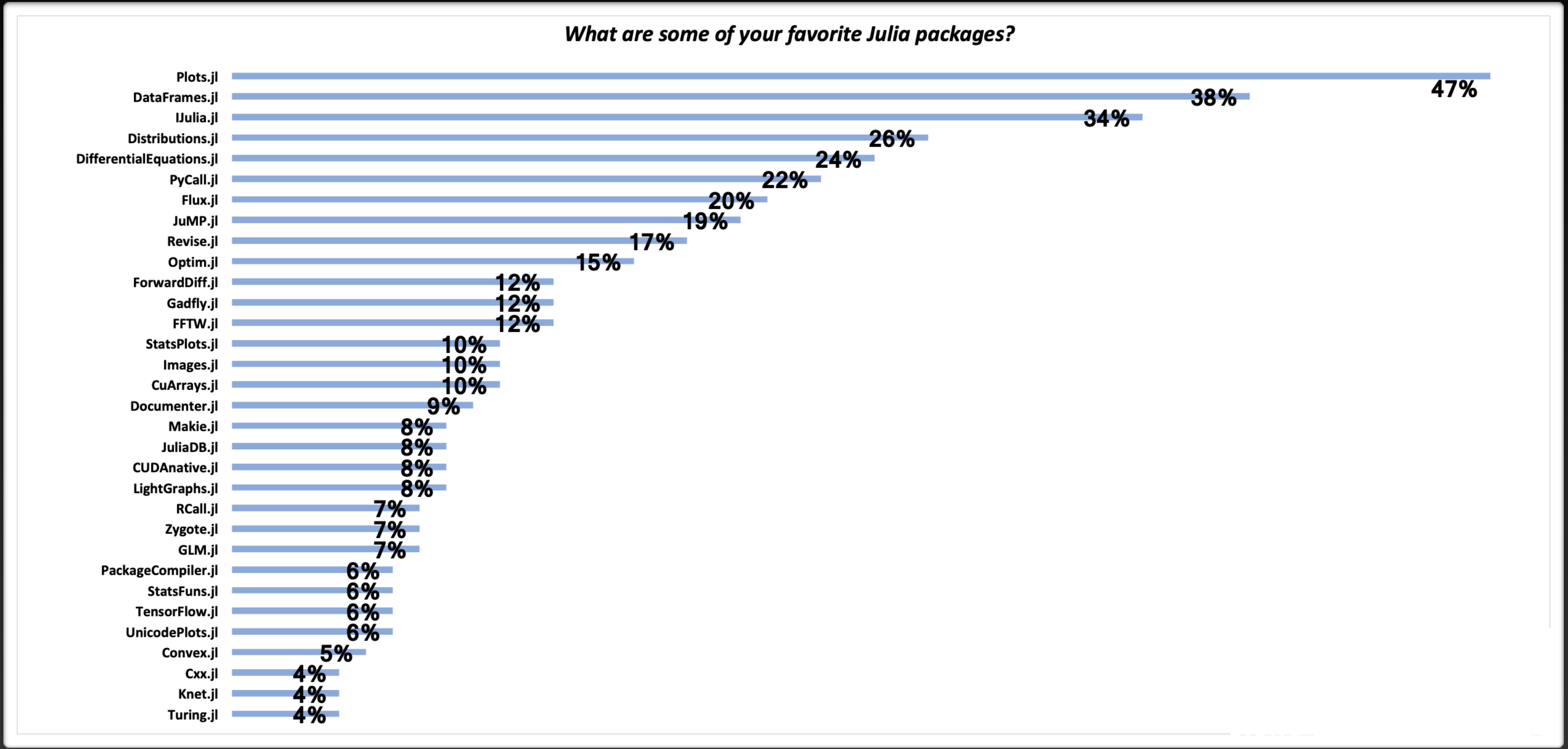


Trending Packages

1	ParallelDataTransfer A bunch of helper functions for transferring data between worker processes	★ 83
2	Thrift Thrift for Julia	★ 18
3	NodeJS Node.js installation for julia	★ 12
4	Twitter Julia package to access Twitter API	★ 46
5	Transducers Efficient transducers for Julia	★ 137
6	GPUifyLoops	★ 54
7	Franklin (yet another) static site generator. Simple, fast, maths with KaTeX, code evaluation, ...	★ 194

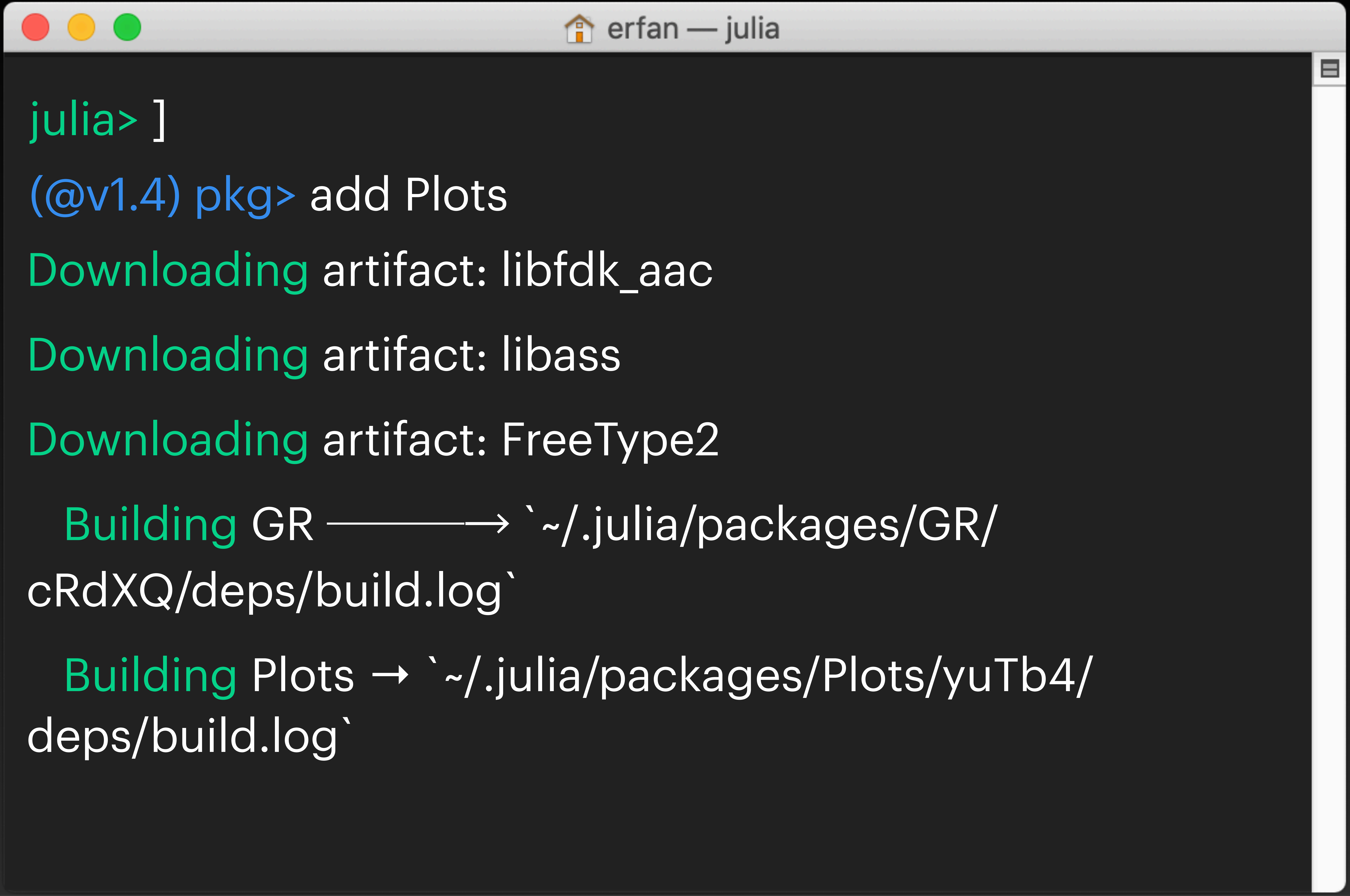
- Data Science
- Graphics
- Machine Learning
- File Io
- Mathematical Optimization
- Statistics
- Graph Theory
- Graphics
- Programming Paradigms
- Super Computing
- Mathematics

Julia Observer

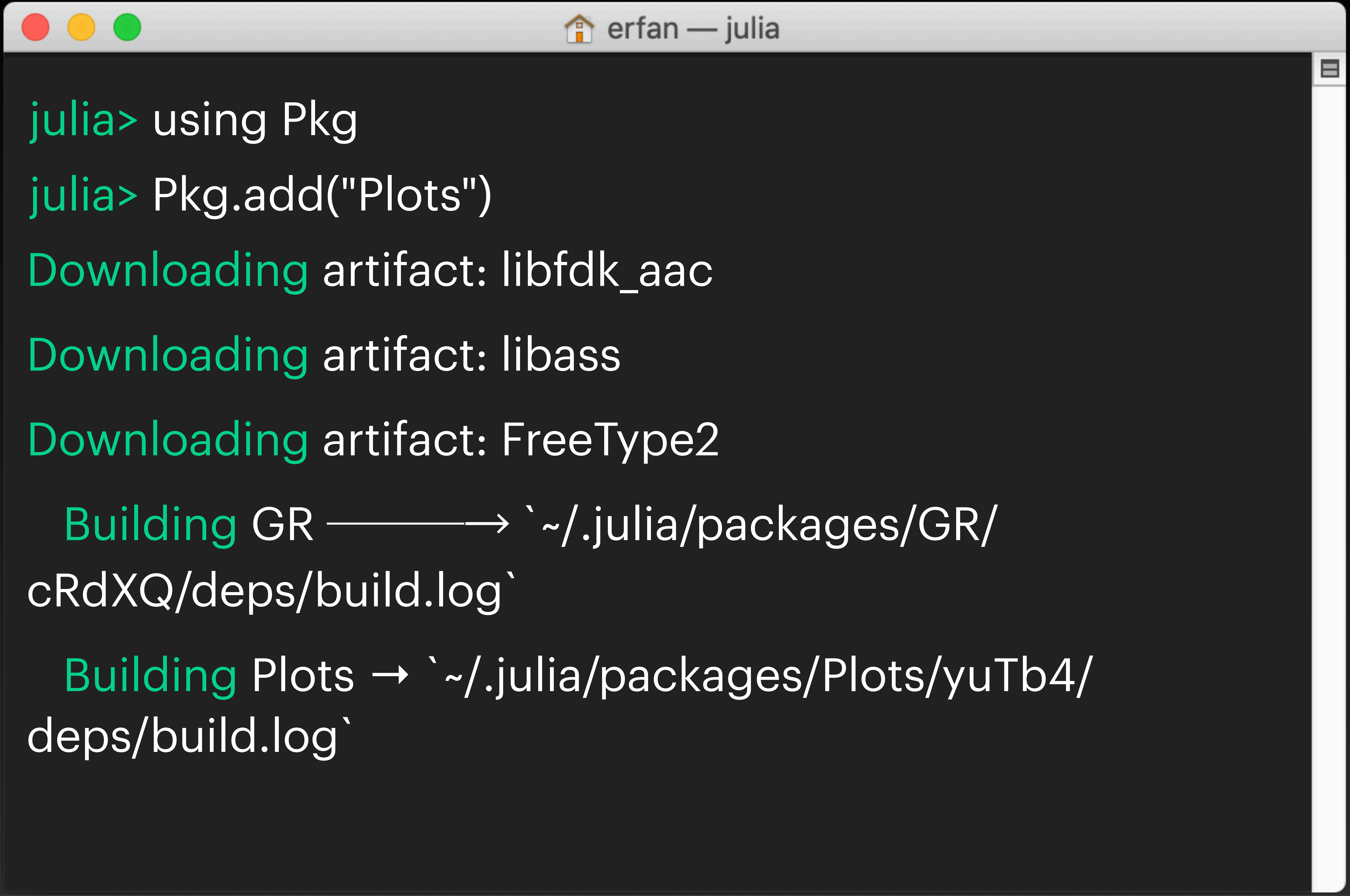


User & Developer Survey 2019, from Julia Computing, Inc.

Installing Packages

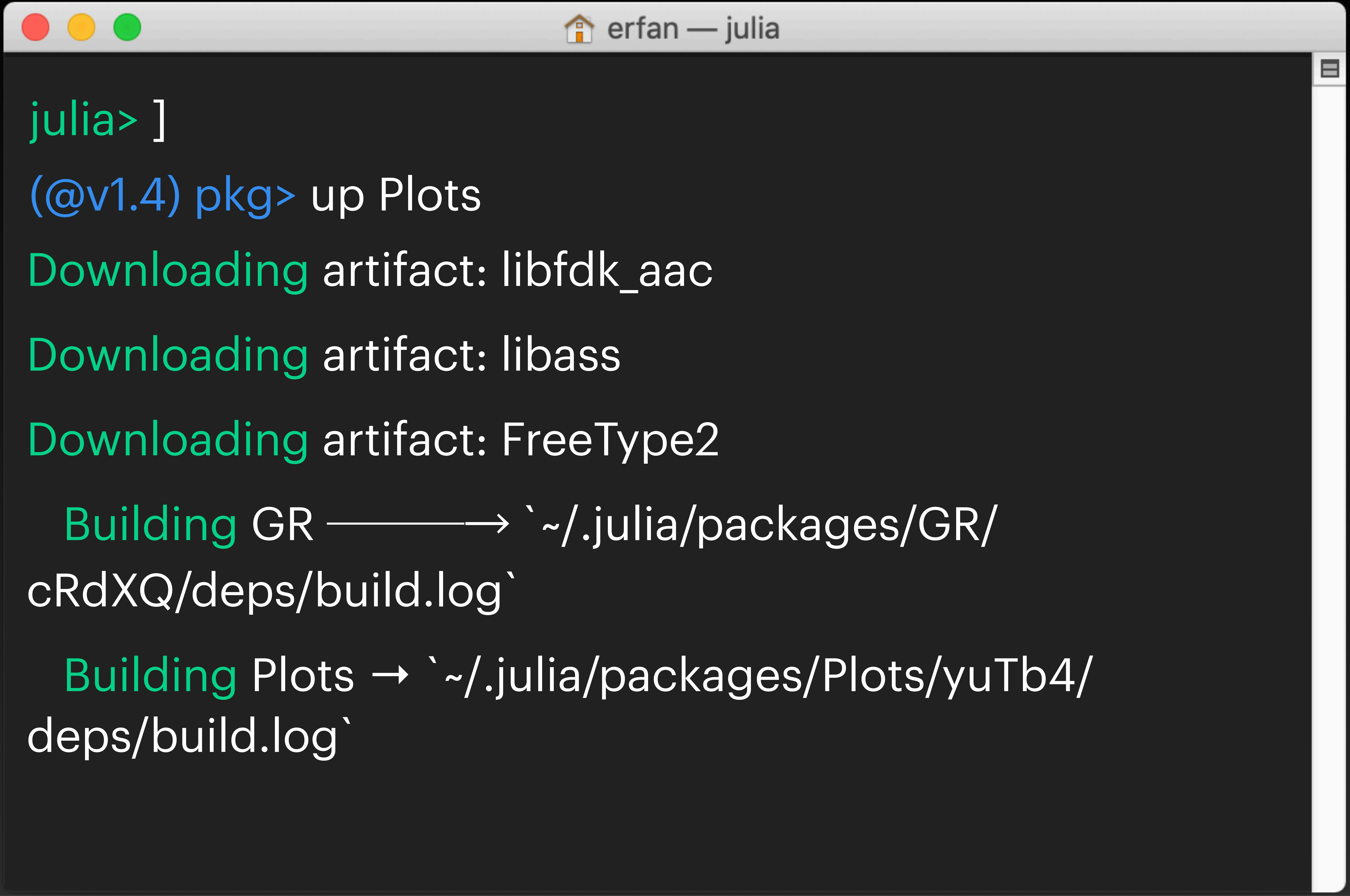


```
julia> ]
(@v1.4) pkg> add Plots
Downloading artifact: libfdk_aac
Downloading artifact: libass
Downloading artifact: FreeType2
  Building GR ———→ `~/.julia/packages/GR/
cRdXQ/deps/build.log`
  Building Plots → `~/.julia/packages/Plots/yuTb4/
deps/build.log`
```



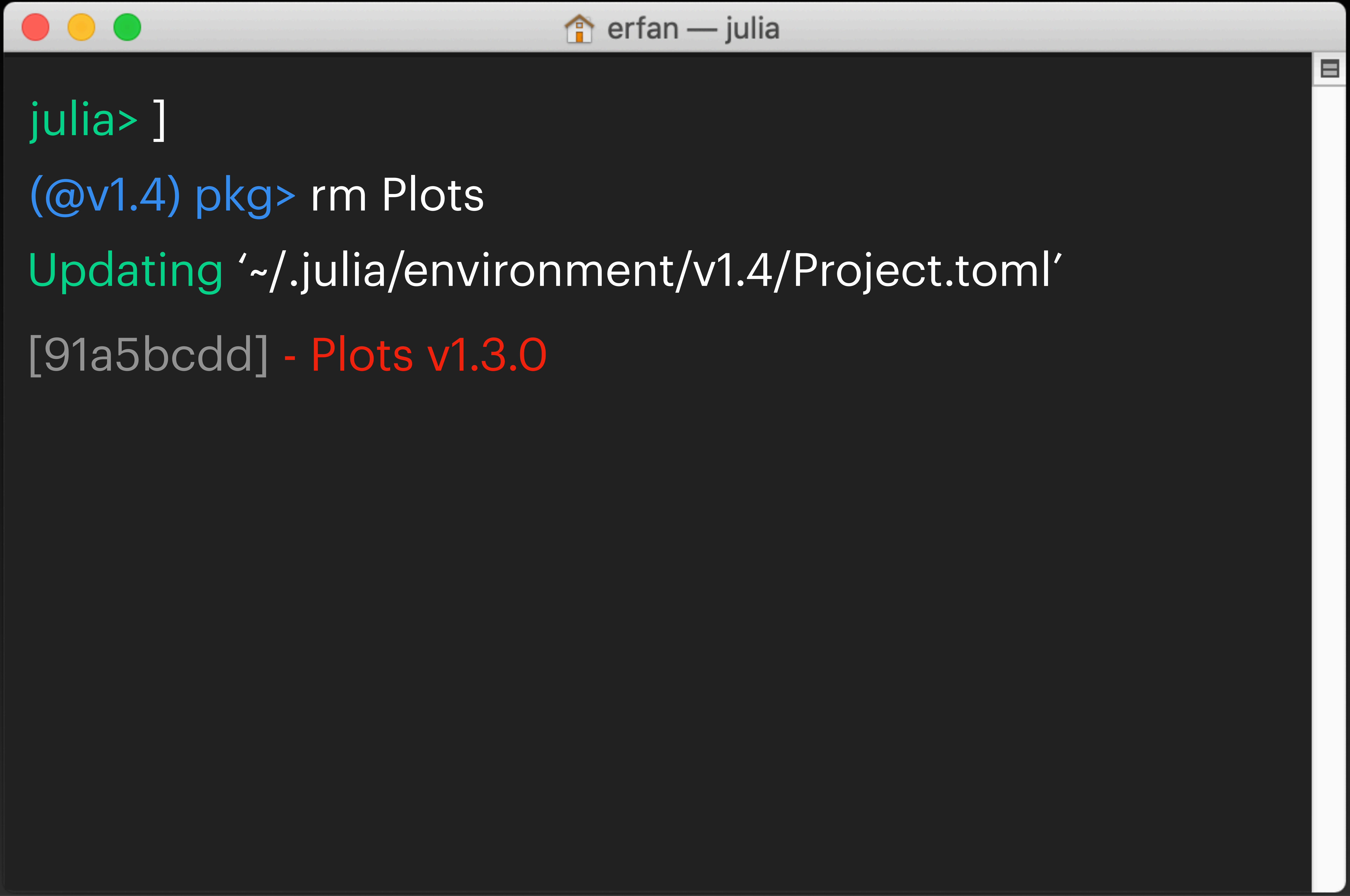
```
julia> using Pkg
julia> Pkg.add("Plots")
Downloading artifact: libfdk_aac
Downloading artifact: libass
Downloading artifact: FreeType2
  Building GR ───────→ `~/.julia/packages/GR/
cRdXQ/deps/build.log`
  Building Plots → `~/.julia/packages/Plots/yuTb4/
deps/build.log`
```

Updating Packages



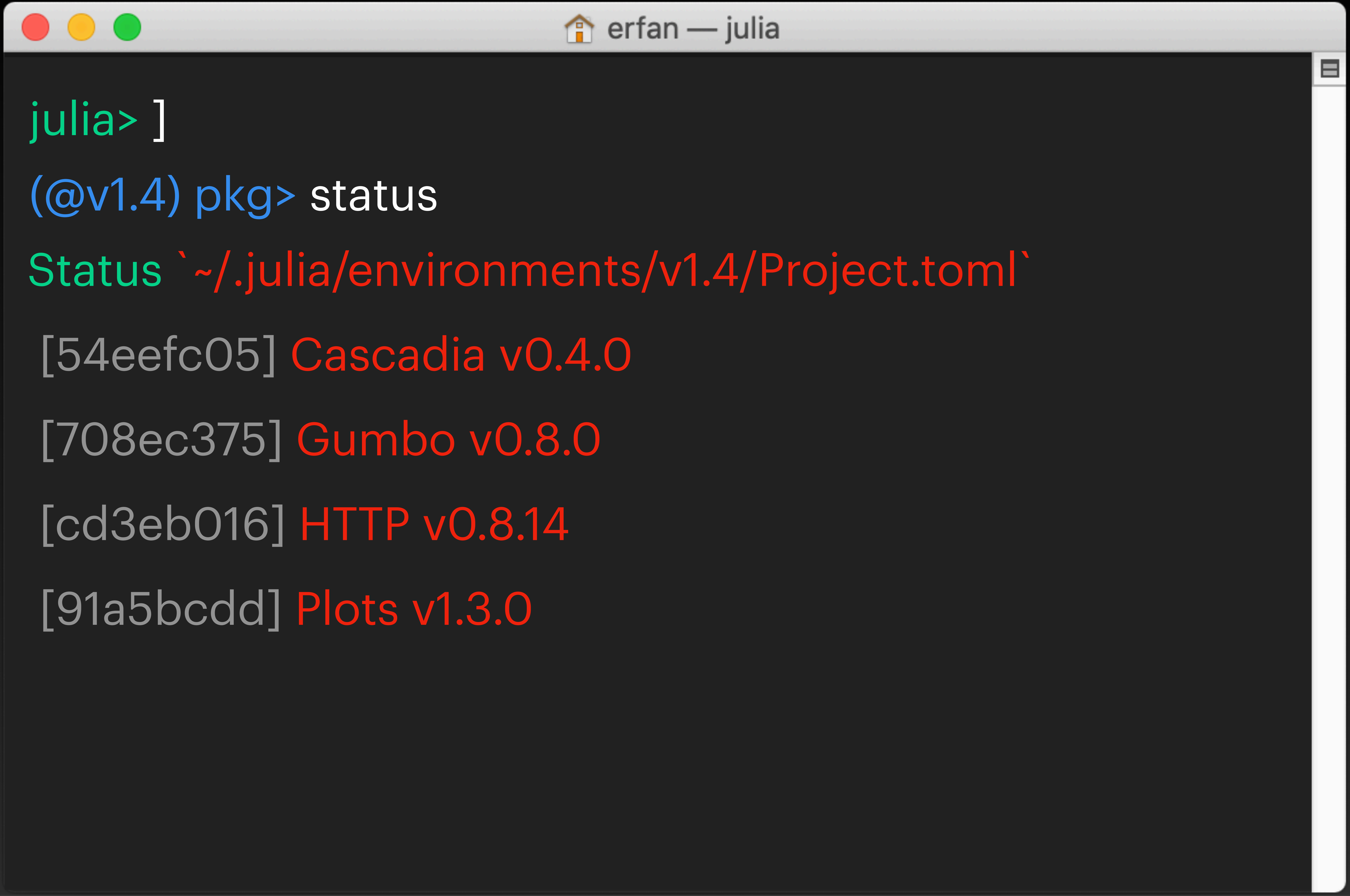
```
julia> ]
(@v1.4) pkg> up Plots
Downloading artifact: libfdk_aac
Downloading artifact: libass
Downloading artifact: FreeType2
   Building GR ————→ `~/.julia/packages/GR/
cRdXQ/deps/build.log`
   Building Plots → `~/.julia/packages/Plots/yuTb4/
deps/build.log`
```

Removing Packages



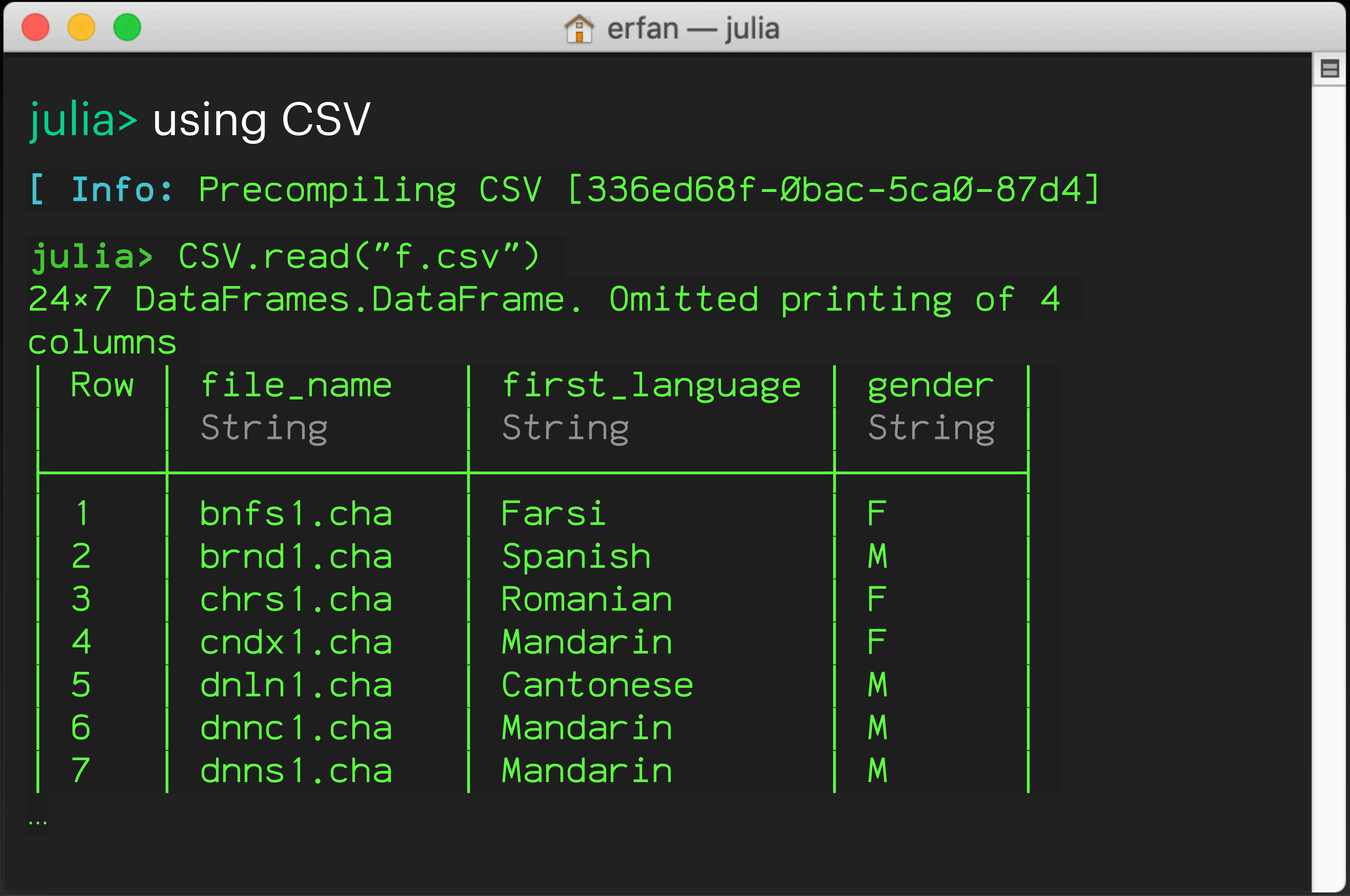
```
julia> ]

(@v1.4) pkg> rm Plots

Updating '~/.julia/environment/v1.4/Project.toml'

[91a5bcdd] - Plots v1.3.0
```

Status of Packages



```
julia> ]

(@v1.4) pkg> status
Status `~/.julia/environments/v1.4/Project.toml`
 [54eefc05] Cascadia v0.4.0
 [708ec375] Gumbo v0.8.0
 [cd3eb016] HTTP v0.8.14
 [91a5bcdd] Plots v1.3.0
```

Using Packages

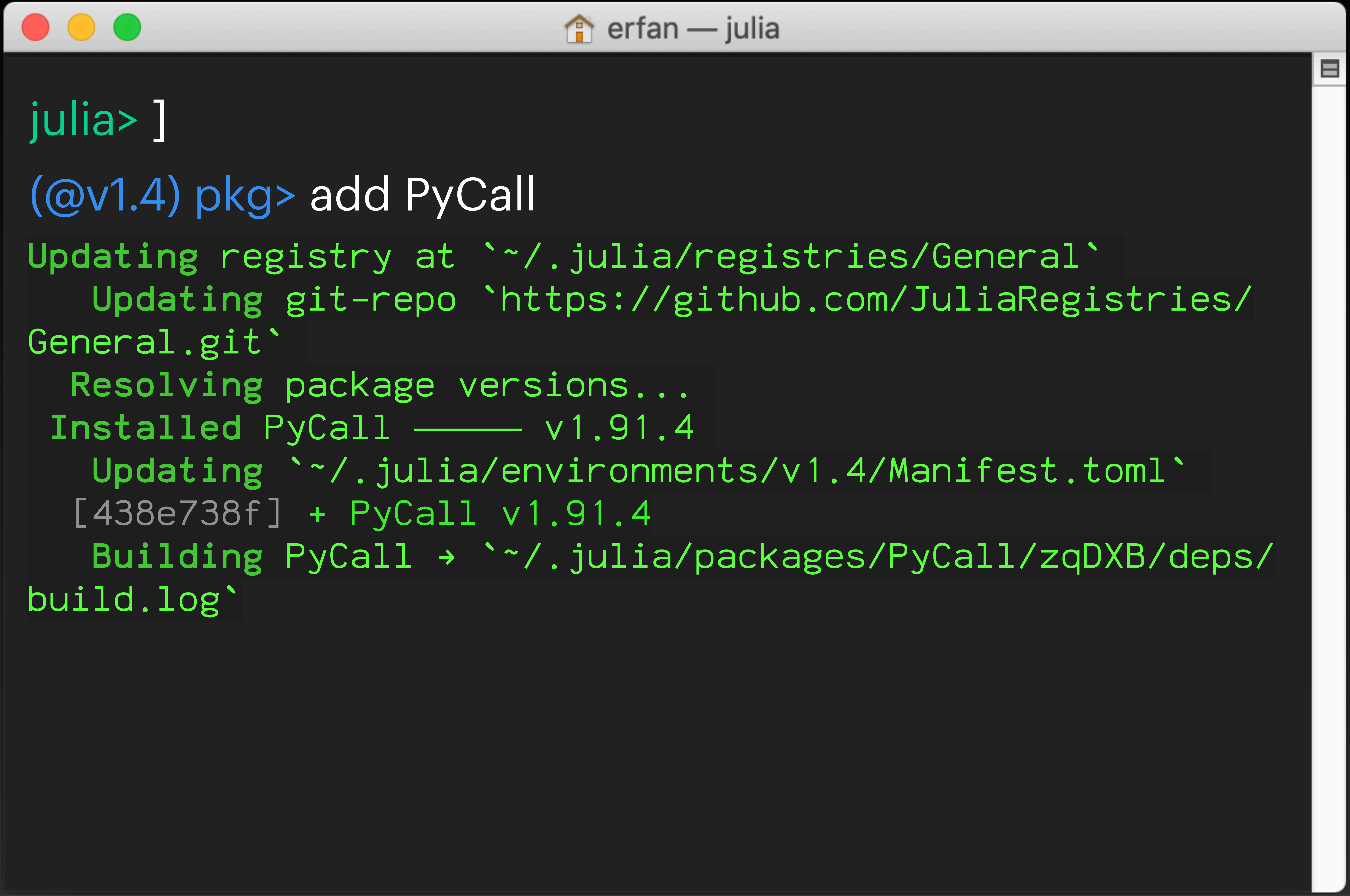


```
julia> using CSV
[ Info: Precompiling CSV [336ed68f-0bac-5ca0-87d4]

julia> CSV.read("f.csv")
24×7 DataFrames.DataFrame. Omitted printing of 4
columns
│ Row │ file_name │ first_language │ gender │
│     │ String    │ String         │ String │
├─────┼───────────┼────────────────┼────────┤
│ 1   │ bnfs1.cha │ Farsi          │ F      │
│ 2   │ brnd1.cha │ Spanish        │ M      │
│ 3   │ chrs1.cha │ Romanian       │ F      │
│ 4   │ cndx1.cha │ Mandarin       │ F      │
│ 5   │ dnln1.cha │ Cantonese      │ M      │
│ 6   │ dnnc1.cha │ Mandarin       │ M      │
│ 7   │ dnns1.cha │ Mandarin       │ M      │
…
```

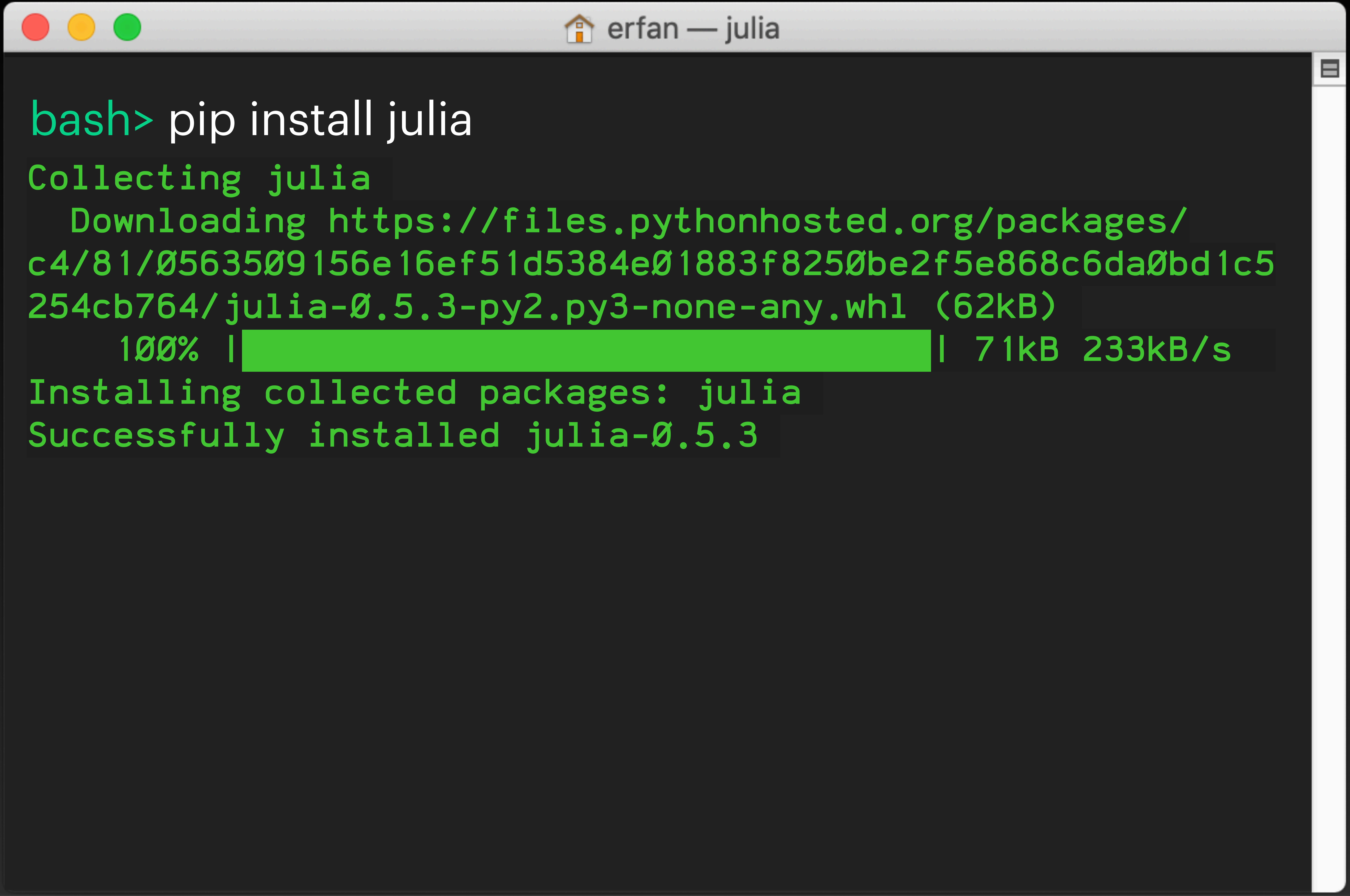
Stylistic Conventions

- Names of variables are in **lower case**. (Letter (A-Z or a-z), underscore, or a subset of Unicode code points greater than 00A0 are allowed.)
- Word separation can be indicated by underscores ('_') (But using it is discouraged unless the name would be hard to read otherwise)
- Names of Types and Modules begin with a **Capital Letter** and word separation is shown with **Upper Camel Case** instead of underscores.
- Names of functions and macros are in **lower case**, without underscores.
- Functions that write to their arguments have names that end in **!**. These are sometimes called "mutating" or "in-place" functions because they are intended to produce changes in their arguments after the function is called, not just return a value. (Check sample codes)

Run Julia in Python



```
julia> ]

(@v1.4) pkg> add PyCall
Updating registry at `~/.julia/registries/General`
   Updating git-repo `https://github.com/JuliaRegistries/
General.git`
  Resolving package versions...
 Installed PyCall ───── v1.91.4
   Updating `~/.julia/environments/v1.4/Manifest.toml`
  [438e738f] + PyCall v1.91.4
   Building PyCall → `~/.julia/packages/PyCall/zqDXB/deps/
build.log`
```

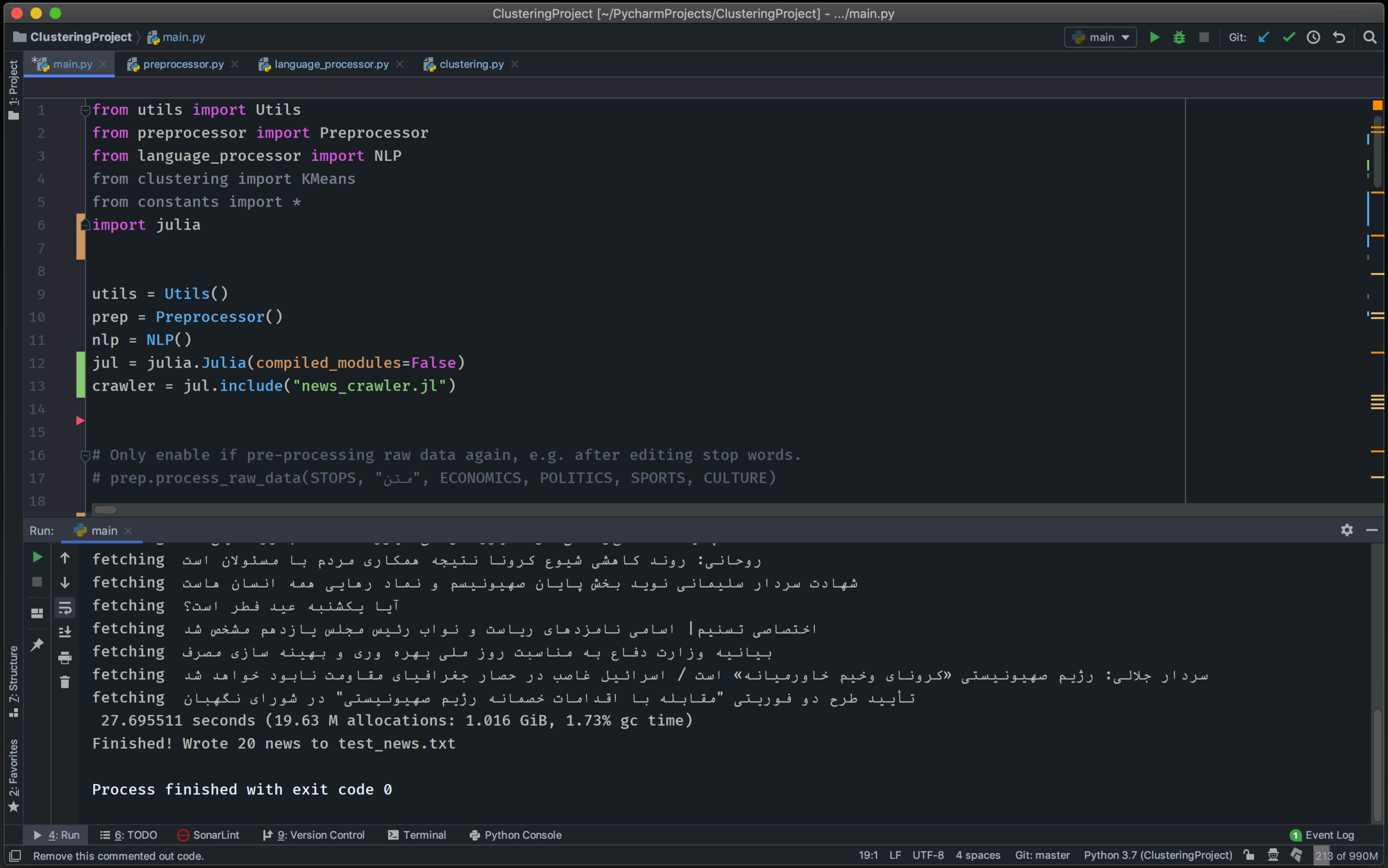


```
bash> pip install julia
Collecting julia
  Downloading https://files.pythonhosted.org/packages/
c4/81/0563509156e16ef51d5384e01883f8250be2f5e868c6da0bd1c5
254cb764/julia-0.5.3-py2.py3-none-any.whl (62kB)
    100% |████████████████████████████████| 71kB 233kB/s
Installing collected packages: julia
Successfully installed julia-0.5.3
```

Run Julia in Python

After installing the packages, add the following lines to your Python program:

```
>>> import julia
>>> jul = julia.Julia(compiled_modules=False)
>>> jl_module = jul.include(“jl_module.jl”)
```

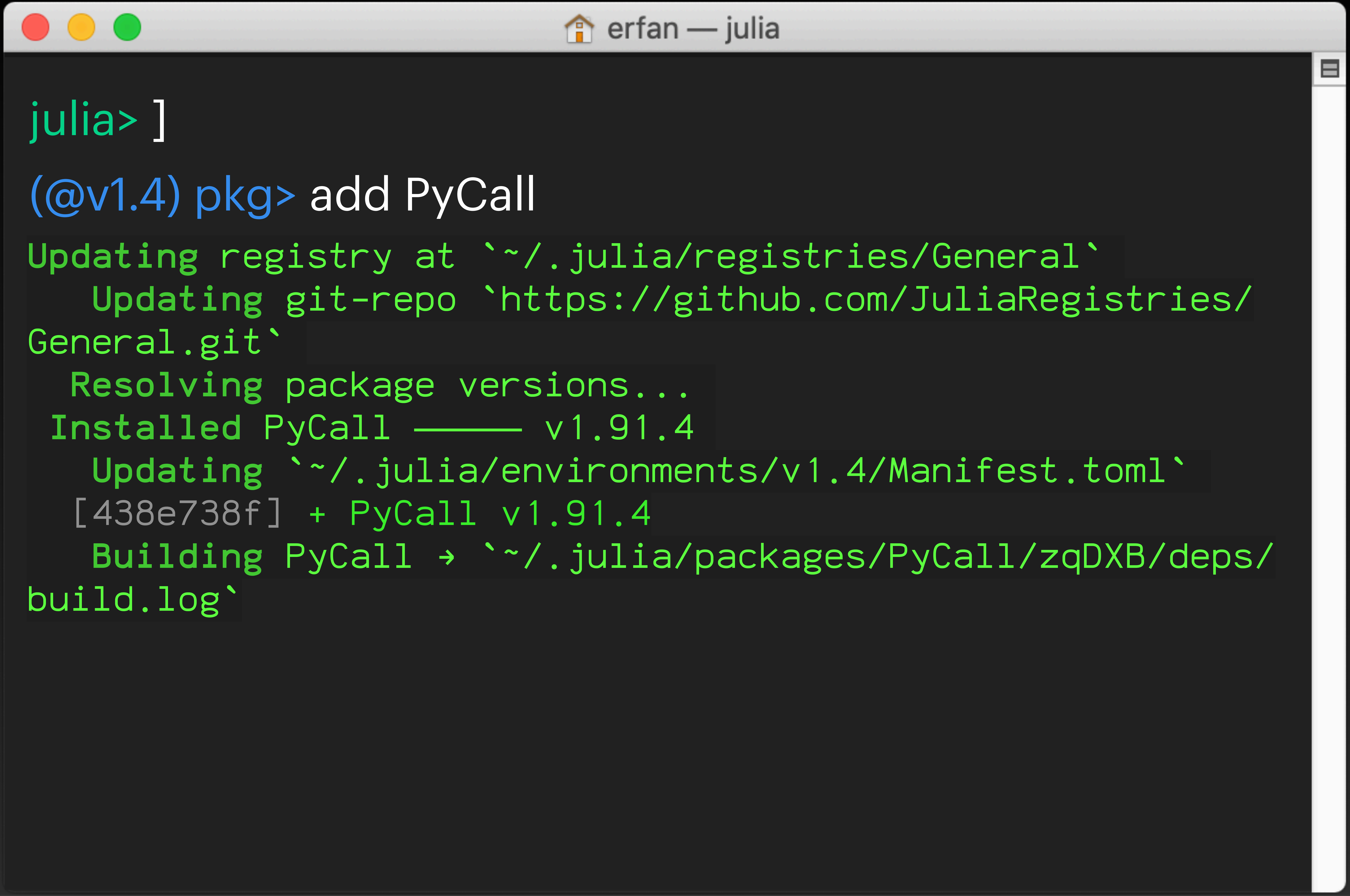


```python
from utils import Utils
from preprocessor import Preprocessor
from language_processor import NLP
from clustering import KMeans
from constants import *
import julia


utils = Utils()
prep = Preprocessor()
nlp = NLP()
jul = julia.Julia(compiled_modules=False)
crawler = jul.include("news_crawler.jl")


# Only enable if pre-processing raw data again, e.g. after editing stop words.
# prep.process_raw_data(STOPS, "متن", ECONOMICS, POLITICS, SPORTS, CULTURE)

```

```
fetching روحانی: روند کاهشی شیوع کرونا نتیجه همکاری مردم با مسئولان است
fetching شهادت سردار سلیمانی نوید بخش پایان صهیونیسم و نماد رهایی همه انسان هاست
fetching آیا یکشنبه عید فطر است؟
fetching اختصاصی تسنیم| اسامی نامزدهای ریاست و نواب رئیس مجلس یازدهم مشخص شد
fetching بیانیه وزارت دفاع به مناسبت روز ملی بهره وری و بهینه سازی مصرف
fetching سردار جلالی: رژیم صهیونیستی «کرونای وخیم خاورمیانه» است / اسرائیل غاصب در حصار جغرافیای مقاومت نابود خواهد شد
fetching تأیید طرح دو فوریتی "مقابله با اقدامات خصمانه رژیم صهیونیستی" در شورای نگهبان
 27.695511 seconds (19.63 M allocations: 1.016 GiB, 1.73% gc time)
Finished! Wrote 20 news to test_news.txt

Process finished with exit code 0
```

Remove this commented out code.

Run Python Packages in Julia



```
julia> ]

(@v1.4) pkg> add PyCall
Updating registry at `~/.julia/registries/General`
   Updating git-repo `https://github.com/JuliaRegistries/
General.git`
  Resolving package versions...
 Installed PyCall ───── v1.91.4
   Updating `~/.julia/environments/v1.4/Manifest.toml`
  [438e738f] + PyCall v1.91.4
   Building PyCall → `~/.julia/packages/PyCall/zqDXB/deps/
build.log`
```

Run Python Packages in Julia

After installing the packages, add the following lines to your Julia program:

```
>>> using PyCall
>>> @pyimport requests
>>> response = requests.get(“url_to_fetch”)
```

Important Tools & Packages

Important Tools & Packages

- Revise.jl: Allows you to modify code and use the changes without restarting Julia (in the same session). Source
- Debugger.jl: A full-fledged debugger for Julia. Source (For Juno check this)
-

Further Resources

Further Resources

- Jupyter Notebooks & Sample Codes for This Lecture
- Noteworthy Differences from Python
- How to Add Julia to Jupyter Notebook
- PyCall: Run Julia in Python
- PyJulia: Run Julia in Python