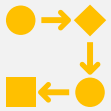
Key features Overview

Syntax

Speed

Package

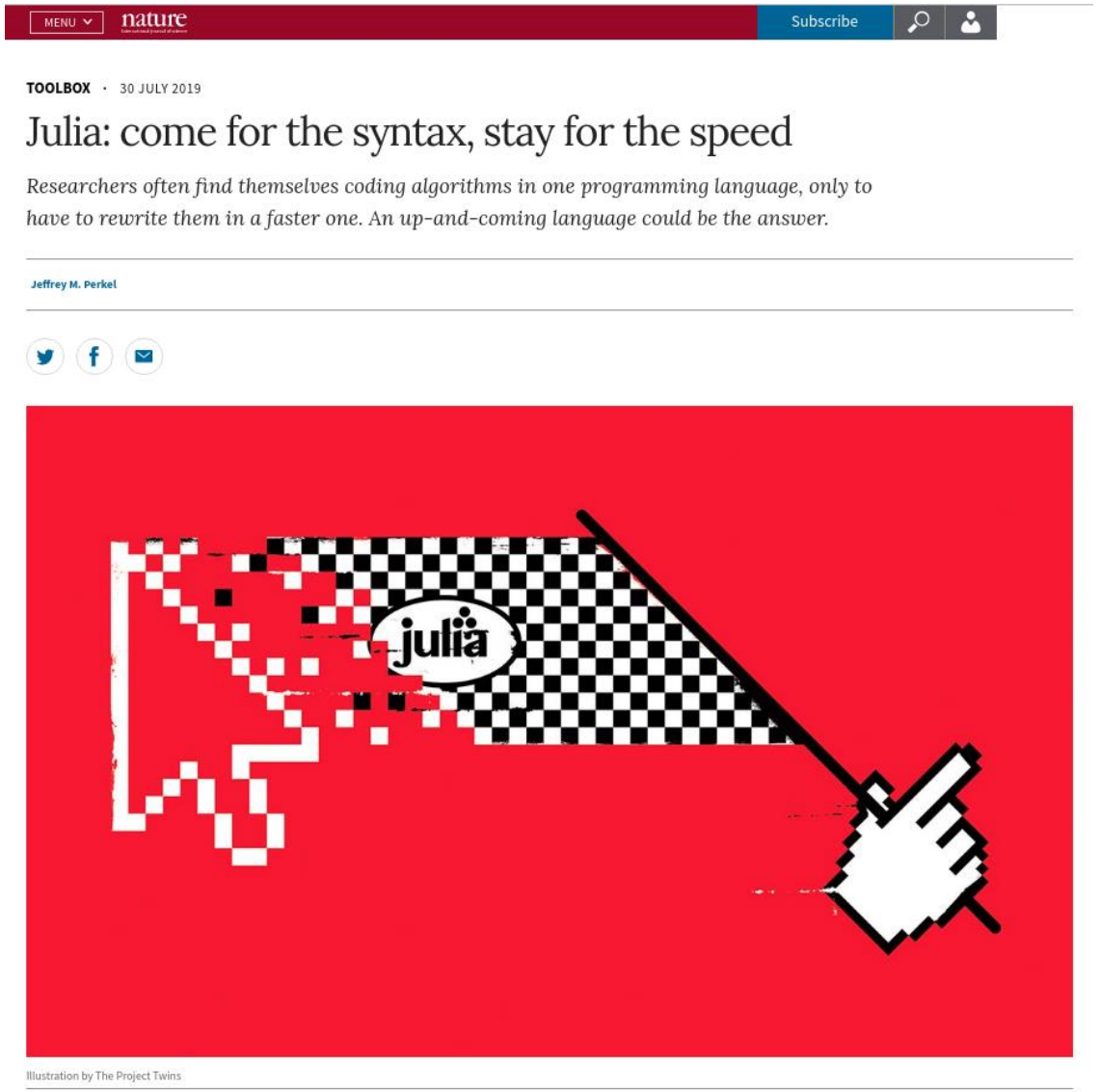


Language binding

Julia Syntax

Recent article (30 July 2019) in Nature journal about Julia:

"*Launched in 2012, Julia is an open-source language that combines the interactivity and syntax of 'scripting' languages, such as Python, Matlab and R, with the speed of 'compiled' languages such as Fortran and C.*"(Jeffrey M. Perkel)



Jeffrey M. Perkel, "**Julia: come for the syntax, stay for the speed**", Nature. 2019 Aug;572(7767):141-142. doi: 10.1038/d41586-019-02310-3.

Julia Syntax

Programming language comparison resources:

- Noteworthy Differences from other Languages
- Python vs R vs Julia for Data Sciences
- Julia Vs R Comparison Cheat Sheet
- MATLAB–Python–Julia cheatsheet
- The Matrix Cheatsheet Matlab–Python-R–Julia comparison

Libraries/Packages

To add a library/package:

```
install.packages("tidyverse")
```

```
conda install anaconda
```

```
Pkg.add(“DataFrames")
```

To load a library/package:

```
library(tidyverse)
```

```
import numpy as np
import pandas as pd
```

```
using DataFrames, CSV, LinearAlgebra
using Statistics, StatsBase
```

Control Structures

if / else if /else

```
if (x == a) {
    ...
} else if (x == b) {
    ...
} else {
    ...
}
```

```
if x == a:
    ...
elif x == b:
    ...
else:
    ...
```

```
if x == a
    ...
elseif x == b
    ...
else
    ...
end
```

for loop

```
for (i in I) {
    ...
}
```

```
for i in I:
    ...
```

```
for i in I
   ...
end
```



Matrix

To create a matrix A_{2x3}

```
A <- matrix(c(1,2,3,4,5,6), 2, 3)
```
```
A = np.array([[1,2,3],[4,5,6]])
```
```
A = [1 2 3; 4 5 6]
```

2 x 2 matrix of zeros

```
A <- zeros(2,2)
```
```
A = np.zeros(2,2)
```
```
A = zeros(2,2)
```

2 x 2 identity matrix

```
A <- eye(2,2)
```
```
A = np.eye(2)
```
```
A = I
```

Select an element in matrix A

```
A[i,j]
```
```
A[i,j]
```
```
A[i,j]
```

Select a row in matrix A

```
A[i,]
```
```
A[i,:]
```
```
A[i,:]
```

Select a column in matrix A

```
A[,j]
```
```
A[:,j]
```
```
A[:,j]
```



Function

To declare

```r
f <- function(x1, x2 = 3) {
    y <- x2 - x1
    y
}
```

```python
def f(x1, x2 = 3):
  y = x2 - x1
  return y
```

```julia
function f(x1, x2 = 3)
    y = x2 - x1
end

# math notation
f(x1, x2) = x2 - x1
```

To call

```r
f(5,12)          # position matters

f(x2=12, x1=5)   # order free
```

```python
f(5,12)          # position matters

f(x2=12, x1=5)   # order free
```

```julia
f(5,12)        # position matters

f(x2=12, x1=5) # if named arguments
```

To pass multiple arguments or keyword arguments to a function

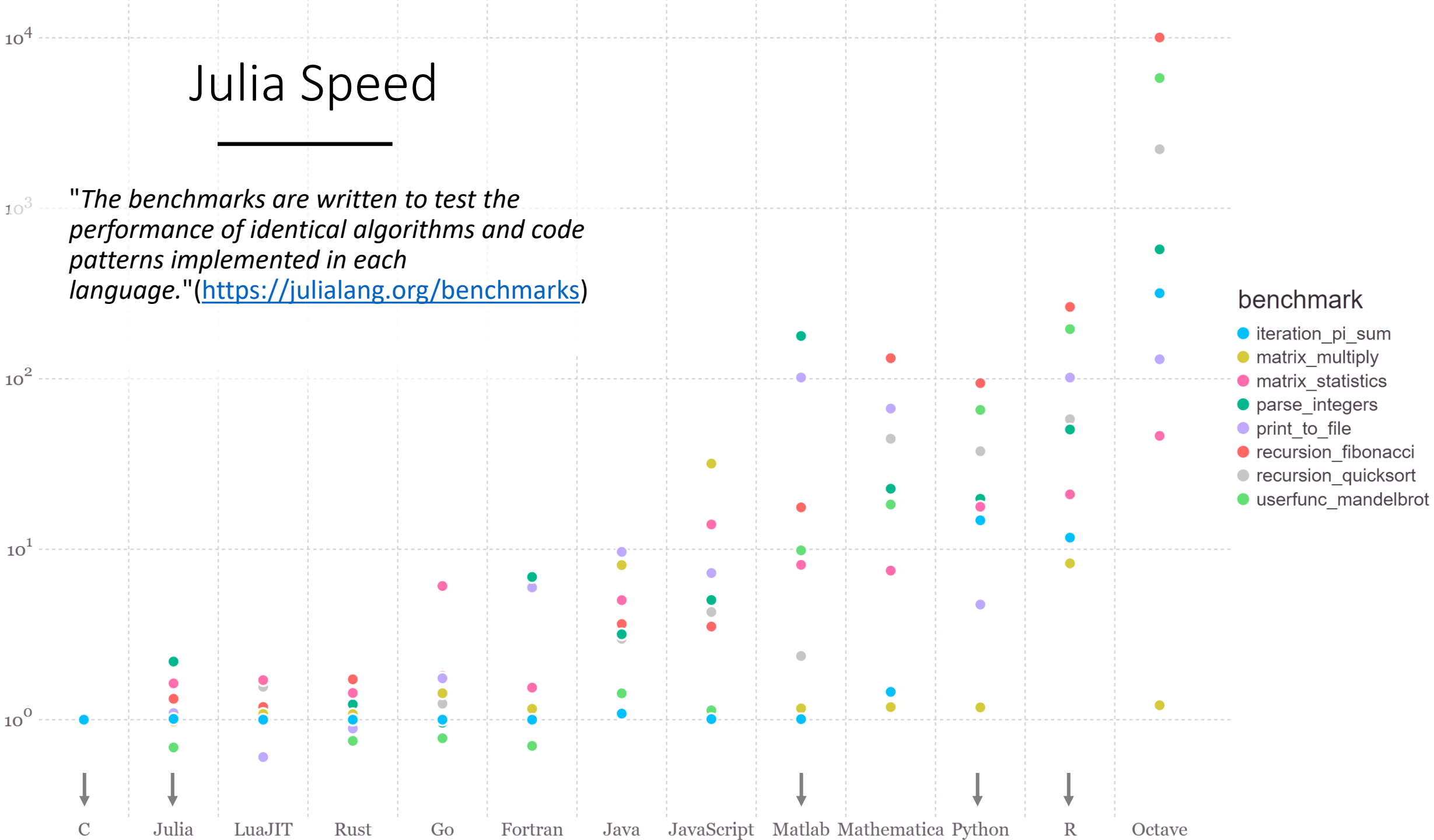
```r
f <- function(x1, x2 = 7, ...) {
    y <- func_foo(x1, x2, ...)
    y
}
```

```python
def f(x1, x2 = 7, *args, **kwargs):
  y = func_foo(x1, x2, args, kwargs)
  return y
```

```julia
function f(x1, x2 = 7, args...;kwargs...)
    y = func_foo(x1,x2,args;kwargs)
end
```

Julia Speed

"*The benchmarks are written to test the performance of identical algorithms and code patterns implemented in each language.*"(https://julialang.org/benchmarks)



Programming languages :

- *Julia 1.6.0*
- *Python 3.9.2*
- *C gcc (Ubuntu 10.3.0-1ubuntu1) 10.3.0*
- *Lisp SBCL 2.1.1*
- *Java openjdk 17 2021-09-14*

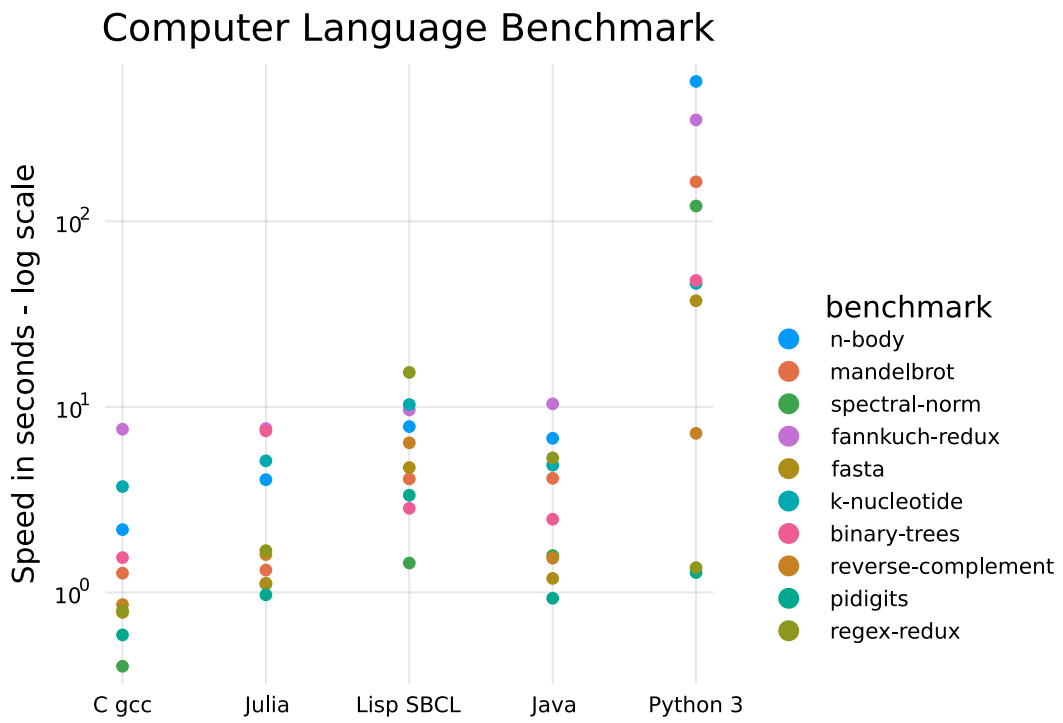
CPU: *quad-core 3.0GHz Intel® i5-3330®*

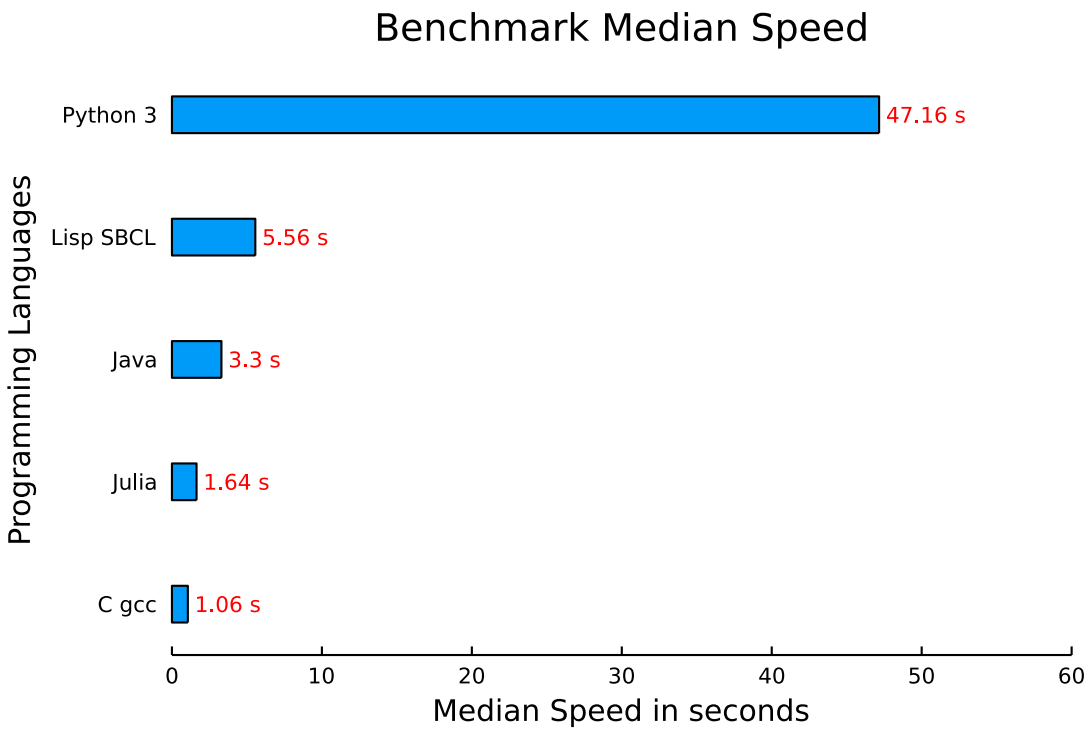
RAM: *15.8 GiB*

HDD: *2TB SATA disk drive*

OS: *Ubuntu™ 21.04 x86_64 GNU/Linux 5.11.0-18-generic*

The Computer Language Benchmarks Games





Julia Packages

Julia has over 6500 registered packages. They are a substantial part of the Julia ecosystem.

To explore existing packages related to your area of interest you can check out the following link: https://juliahub.com/ui/Packages

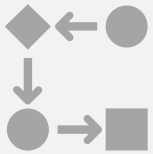
Julia comes with a built-in package manager named Pkg, but it also com with an interactive Package Mode: Example

Julia Packages Worth Mentioning

- **Statistics and Math:** `StatsBase` (Basic functionalities for statistics), `LinearAlgebra` (Linear algebra operations), `Distributions` (Probability distributions), `GLM` (Generalized linear models), `Turing` (Bayesian Inference)
- **Data tools:** `DataFrames` (Essential tools for tabular data), `Queryverse` (A meta package for data science), `CSV` (For working with CSV files), `XLSX` (Excel file reader and writer)
- **Biology:** `Bio` (Framework for computational biology and bioinformatics)
- **Machine Learning:** `Flux` (ML library), `TensorFlow` (A wrapper around TensorFlow), `Knet` (Deep learning framework), `FScikitLearn` (Scikit-learn framework)
- **Plot:** `Plots` (Julia visualizations and data analysis), `PyPlot` (matplotlib plotting like), `Gadfly` (ggplot2 plotting like), `UnicodePlots` (Unicode-based scientific plotting for working in the terminal)
- **Language binding:** `PyCall` (For Python calling), `RCall` (For R calling)
- **Jupyter:** `IJulia` (Julia kernel)

Language Binding

Even though, the package ecosystem still has room to grow. Julia has excellent foreign function interfaces. Easily call into other languages such as python with with `PyCall` or R with `Rcall`.



This means that you don’t have to wait until the Julia ecosystem is fully mature, and that you don’t have to give up your favorite package/library from another language when moving to Julia!