Python for Scientific Computhing

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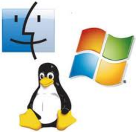
New Tasks

gui

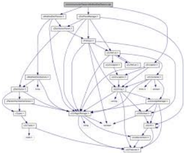
http://www.

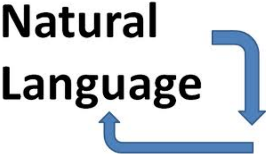
MySQL®



Simula
Visual C++
Visual Basic
APL
HTML
Algol
Oberon
Cobol
PL/I
Eiffel
Fortran
Basic
awk
Prolog
Lisp
ADA
C++
Icon
sed
Pascal
C
Modula-2
Smalltalk
Snobol
perl
Scheme
Delphi
JAVA

<?xml?>




Natural
Language

10
9
8

New Tool

What is Python?

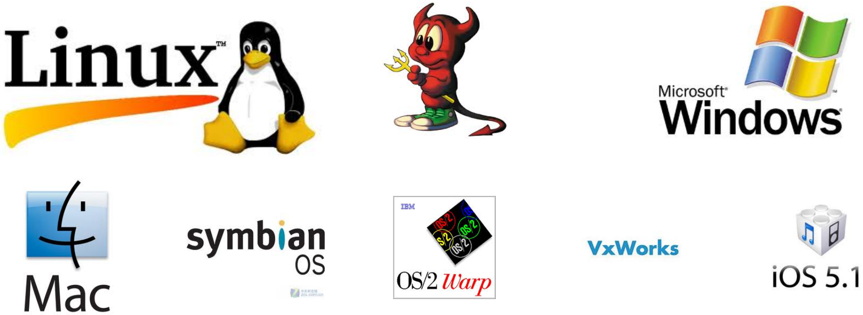
a remarkably powerful dynamic programming language.

Guido van Rossum
Benevolent Dictator For Life

Python's feature

- free and opensource

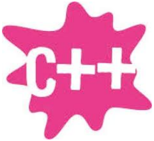
- runs everywhere

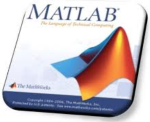


Python's feature

- plays well with others

Microsoft®
.NET

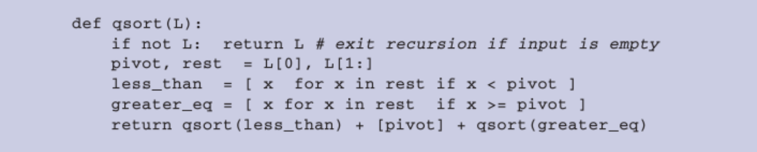




Python's feature

- very clear,readable syntax

Implementing the basic QuickSort algorithm in Python

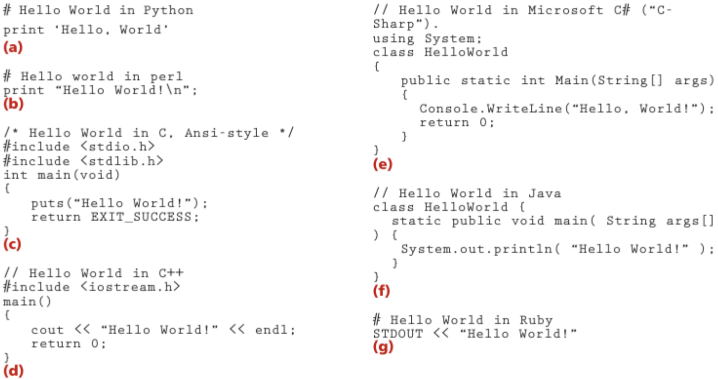


```
def qsort(L):
    if not L:  return L # exit recursion if input is empty
    pivot, rest   = L[0], L[1:]
    less_than   = [ x  for x in rest if x < pivot ]
    greater_eq = [ x for x in rest  if x >= pivot ]
    return qsort(less_than) + [pivot] + qsort(greater_eq)
```

- Mandatory indentation

- boosts developer productivity
  Python code is typically $\frac{1}{3}$ to $\frac{1}{5}$ the size of equivalent C++ or Java code.

Figure A. Traditional “Hello, World!” program in various languages: Python (a), Perl (b), Ansi C (c), C++ (d), C# (e), Java (f), and Ruby (g).



```
# Hello World in Python
print ‘Hello, World’
```

(a)

```
# Hello world in perl
print “Hello World!\n”;
```

(b)

```
/* Hello World in C, Ansi-style */
#include <stdio.h>
#include <stdlib.h>
int main(void)
{
   puts(“Hello World!”);
   return EXIT_SUCCESS;
}
```

(c)

```
// Hello World in C++
#include <iostream.h>
main()
{
   cout << “Hello World!” << endl;
   return 0;
}
```

(d)

```
// Hello World in Microsoft C# (“C-
Sharp”).
using System;
class HelloWorld
{
   public static int Main(String[] args)
   {
     Console.WriteLine(“Hello, World!”);
     return 0;
   }
}
```

(e)

```
// Hello World in Java
class HelloWorld {
  static public void main( String args[]
) {
   System.out.println( “Hello World!” );
  }
}
```

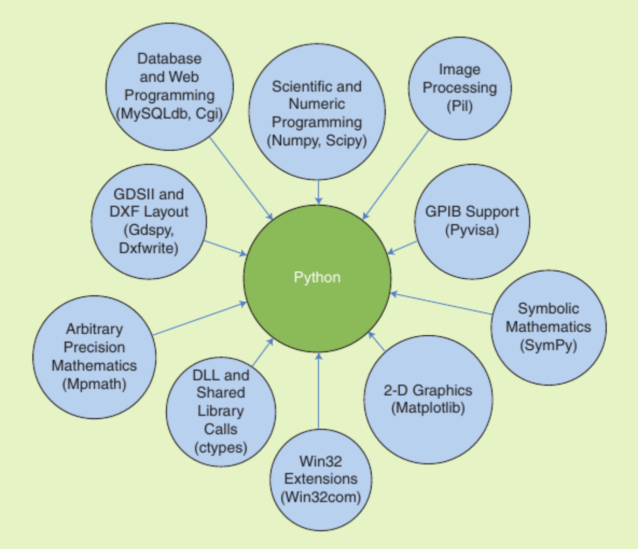
(f)

```
# Hello World in Ruby
STDOUT << “Hello World!”
```

(g)

How to replace Matlab?

Python:An Ecosystem for Scientific Computing

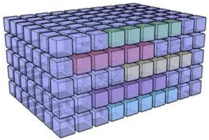


Database and Web Programming (MySQLdb, Cgi)
Scientific and Numeric Programming (Numpy, Scipy)
Image Processing (Pil)
GDSII and DXF Layout (Gdspy, Dxfwrite)
Python
GPIB Support (Pyvisa)
Symbolic Mathematics (SymPy)
Arbitrary Precision Mathematics (Mpmath)
DLL and Shared Library Calls (ctypes)
2-D Graphics (Matplotlib)
Win32 Extensions (Win32com)

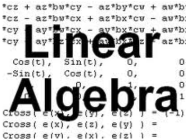
NumPy

N-dimensional Array manipulations

- N-dimensional array object

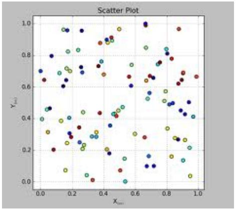


- linear algebra functions



- Fourier transforms

- random number capabilities



SciPy

Scientific tools for Python

a library of scientific tools
depends on the NumPy

SciPy provides moudles for

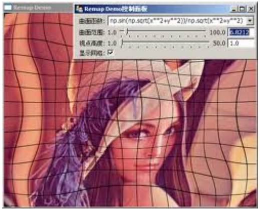
- statistics
- optimization
- numerical integration
- linear algebra
- Fourier transforms

- signal processing
- image processing
- ODE solvers
- special functions
- ...

Image Processing

- PIL

- pyopencv



Remap Demo

Remap Demo控制面板

曲面函数: np.sin(np.sqrt(x**2+y**2))/np.sqrt(x**2+y**2)

曲面范围: 1.0 100.0 5.8212

视点高度: 1.0 50.0 1.0

显示网格: ☑

SymPy

SymPy is a Python library for symbolic mathematics.

SymPy provides moudles for

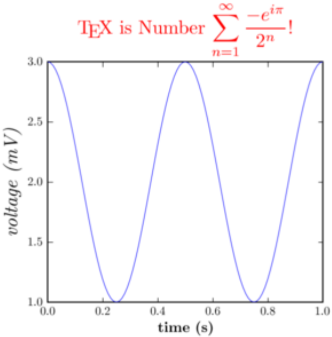
- Core capabilities
- Polynomials
- Calculus
- Solving equations
- Discrete math
- Matrices

- Geometric Algebra
- Geometry
- Plotting
- Physics
- Statistics
- Printing

matplotlib

a python 2D plotting library

matplotlib is Object-Oriented and its syntax looks like matlab's.


$\TeX$ is Number $\sum_{n=1}^{\infty}\frac{-e^{i\pi}}{2^n}$!
voltage (mV)
3.0
2.5
2.0
1.5
1.0
0.0
0.2
0.4
0.6
0.8
1.0
time (s)

Tips:It is neccessary to get a handle on its inheritance relationship.

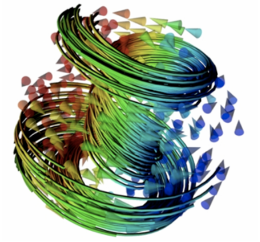
Mayavi Project

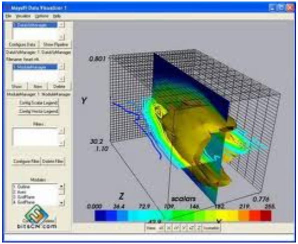
3D Scientific Data Visualization and Plotting

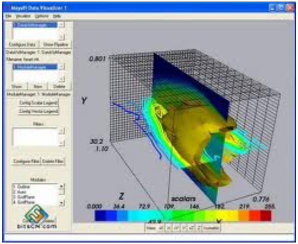
The Mayavi project includes two related packages for 3-dimensional visualization:

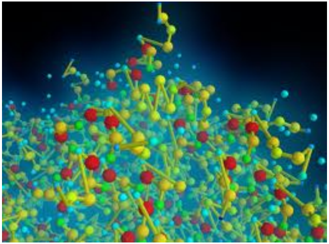
- Mayavi: A tool for easy and interactive visualization of data, with seamless integration with Python scientific libraries.
- TVTK: A Traits-based wrapper for the Visualization Toolkit, a popular open-source visualization library.

MayaVi Screenshots



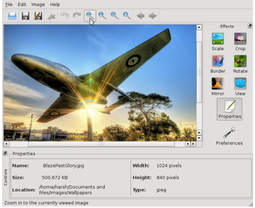






GUI Programming

- PyQt



Properties

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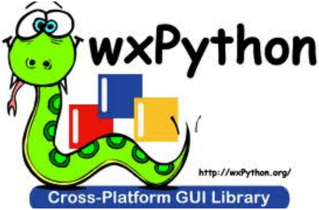
Width: 1024 pixels

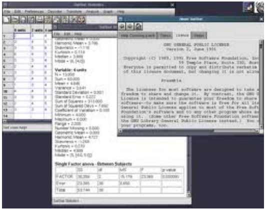
Height: 840 pixels

Type: jpeg

Zoom in to the currently viewed image

- wxPython





Tkinter PyGtk PyGUI PyKDE ...

PyPy

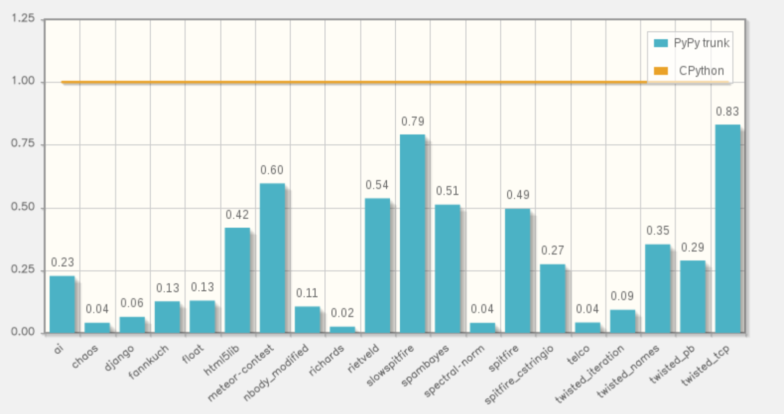
the coming future

PyPy is a fast, compliant alternative implementation of Python. It has several advantages and distinct features:

- Much faster speed(thanks to JIT)
- Less memory usage
- Highly compatible
- Sandboxing
- Stackless

pypy logo artwork
2009/12/07 samuel reis

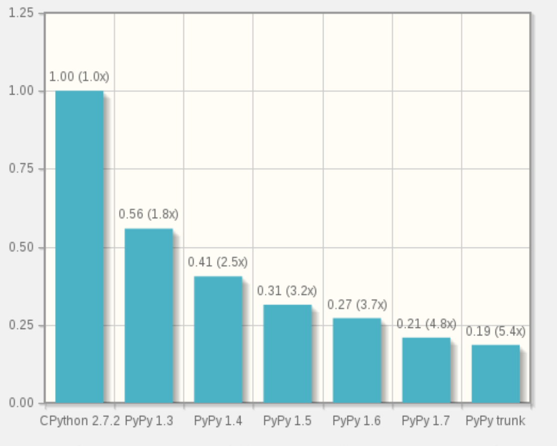
How fast is PyPY?



Plot 1: The above plot represents PyPy trunk (with JIT) benchmark times normalized to CPython. Smaller is better.

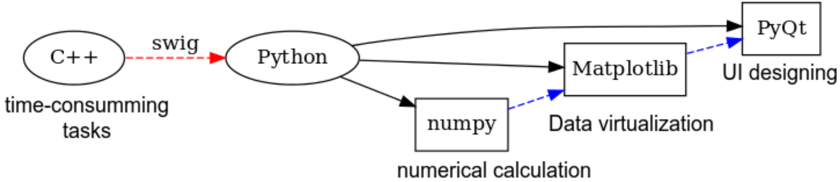
It depends greatly on the type of task being performed. The geometric average of all benchmarks is 0.19 or 5.4 times faster than CPython

PyPy is evolving



Summary

an efficient frame for scientific computing


C++
swig
Python
PyQt
Matplotlib
numpy
time-consumming tasks
UI designing
Data virtualization
numerical calculation