Python Coding Practice

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Figure 1: Python's logo.

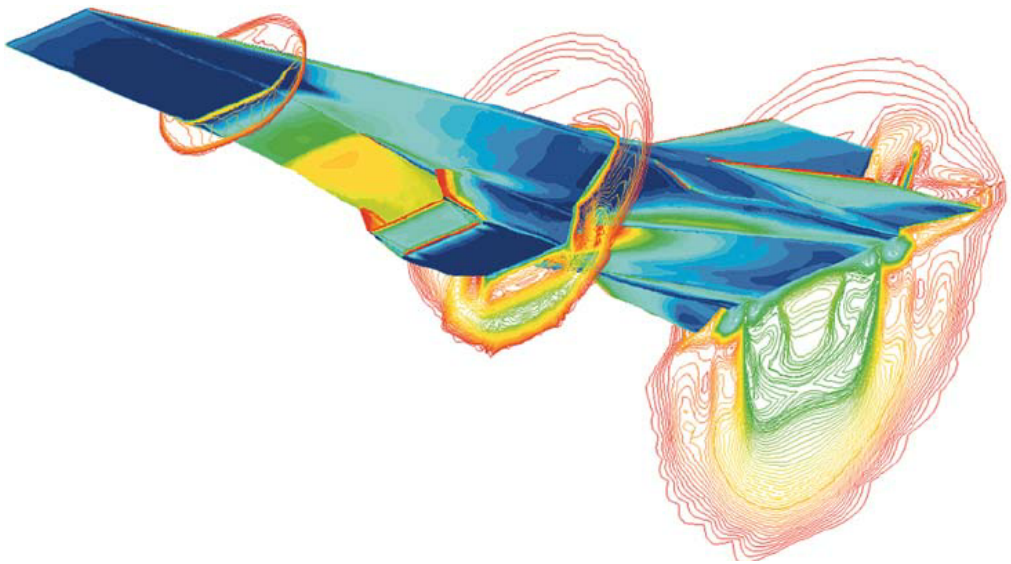


Figure 2: CFD result of HyperX at Mach 7 from NASA

A Little Background

- Created by: Guido van Rossum, 1989-1991
- Why: The creator wanted something easy to use.
- Is it really that easy? Yes (and no)
- Very readable with little memory management.
- `https://people.sc.fsu.edu/~jburkardt/`
- `https://docs.python.org/3/tutorial/index.html`
- `https://www.tutorialsteacher.com/python`
- `https://www.w3schools.com/python/default.asp`
- `https://www.tutorialspoint.com/python/` $\longleftarrow$ great place to start.

A Little More About Python

- Python2 $\longrightarrow$ Python3; support for Python2 will end 2020.
- This workshop is exclusively on Python3 $\longrightarrow$ refer to just Python
- Python is fully object oriented. Everything is considered object.
- Famous for AI and machine learning $\longrightarrow$ Pytorch, Keras, TensorFlow
- Interpreter language but can be compiled $\longrightarrow$ Cython, Numba
- Very well documented. Every module/libraries are documented online.
- Package management by package installer $\longrightarrow$ pip, pip3
- pip $\longrightarrow$ `https://pypi.org/project/pip/`
- **Py**thon **P**ackage **I**ndex $\longrightarrow$ pypi, `https://pypi.org/`
- `https://github.com/` $\longleftarrow$ another place to look.

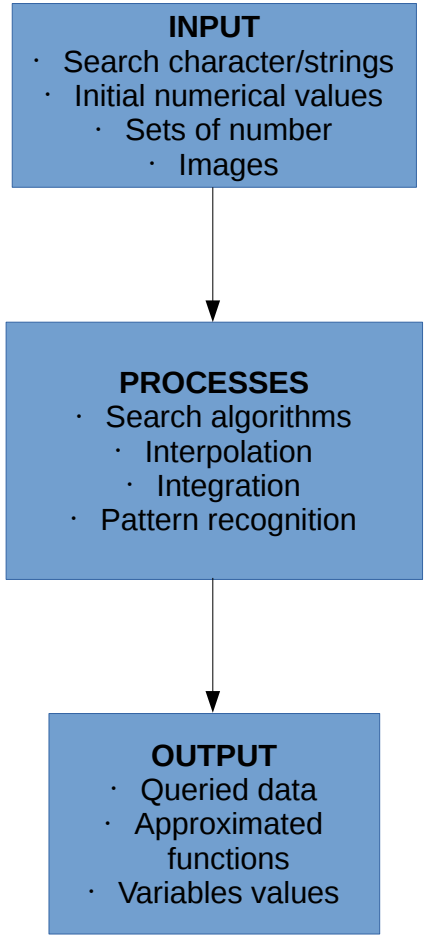
About Anaconda

- No, its not a different programming language.
- Anaconda is a *complete environment* for Python programming.
- Most major scientific package (NumPy, SciPy etc) are included.
- Package installer *conda*

```
user@pc-name:~/conda install any_package
```

- `https://www.anaconda.com/`

About programming



About programming

- Coding paradigm
  - programming language == English (sorry, Mandarin not required)
  - syntax is based on English
  - coding is a reduction of English instructions
- Syntax must be remembered
  - read the manual $\longrightarrow$ documentations are vital
  - memorize THE MOST COMMONLY USED syntax only
  - good algorithm will always beats bad algorithm
- I don't remember every syntax so you have to bare with me 😐

Installation

- Download from `https://www.python.org/`
- For Ubuntu download from repository:

```
user@pc-name:~/apt install python3
```

- For Windows, download from `https://www.python.org/downloads/windows/`
- For Ubuntu installing packages:

```
user@pc-name:~/pip3 install numpy
```

- For Windows installing packages if $C:\backslash Python\backslash Scripts\backslash$ is in the path:

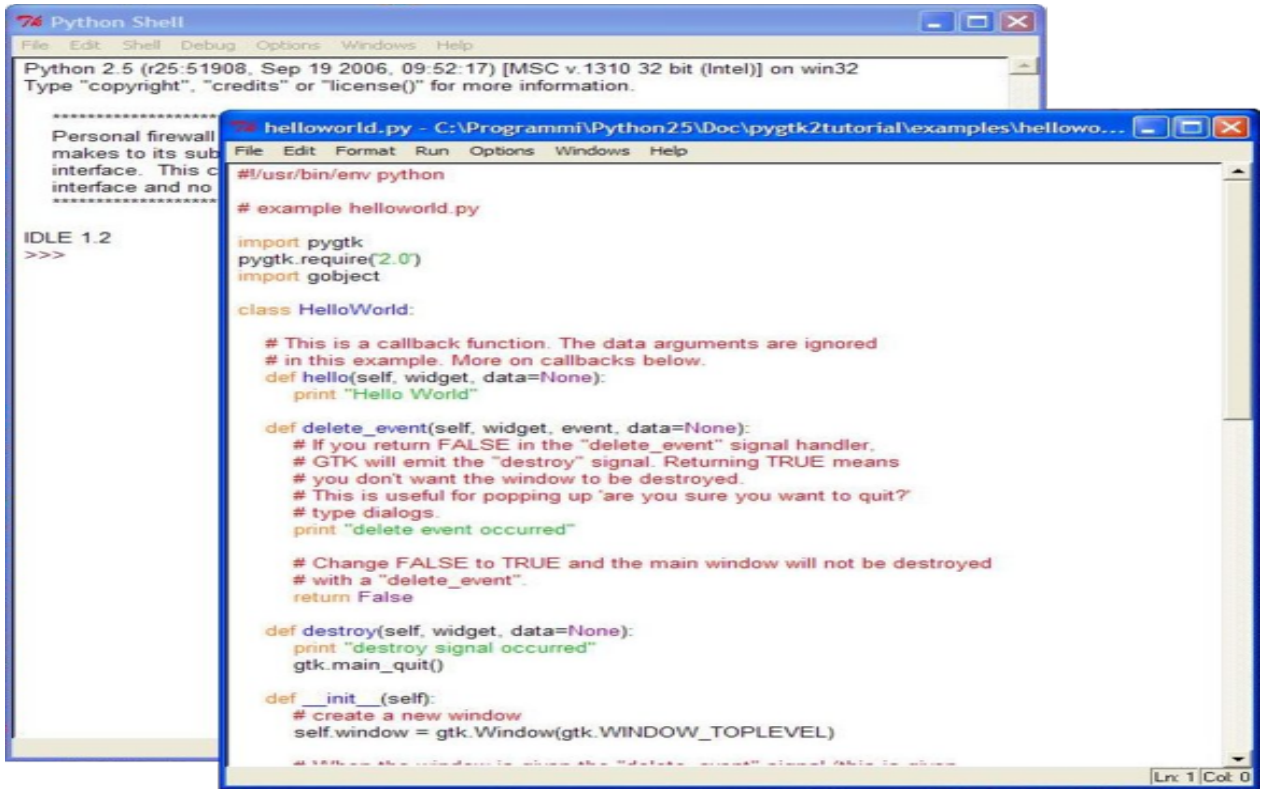
```
C:\User\dummy\> pip3 install numpy
```

- For Windows installing packages:

```
C:\User\dummy\> python3 -m pip3 install numpy
```

Introduction

- For Windows, the default editer is IDLE



Hello, Python!

- Symbols to remember.

```
#everything about the basics

'''
This is how you put a long comment.
: <- colon
; <- semi-colon
() <-parentheses
[] <-brackets
{} <- braces
# <- hash sign
' <- apostrophe
" <- quote mark
.....
Thats about everything you need to know/remember
'''
```

file: py-hello.py

Hello, Python!

- The print() function.

```
print("Hello,world!")
print("Hello, Python 3\n") # "\n"; next line
money=4.0
print("I have %f B, in a yacht somewhere"%money)
var0 = 1
var1 = 1.07
print("To print float number %f and integer %d"%(var1, var0))
str1 = "Another way "
str2 = "to add something."
print(str1+str2)
print(str1+"\t"+str2) # "\t" for tab spacing
```

file: py-hello.py

Basic I/O including files.

- Basic I/O from terminal.

```
#Basic terminal input
var0 = input("Enter something:")
print(var0) #input by default is STRING ONLY!

var1 = input("Enter integer: ")
var1 = int(var1)
print(var1, var1+var1)
print(var1, var1, var1, var1) #you can print a lot

var2 = input("Enter real number: ")
var2 = float(var2)
```

file: py-basic-io.py

Basic I/O including files.

- Write to file and close.

```
fo = open("test.txt","w+")
fo.write("Test file\n")
fo.close()
```

- Write to file with different access mode.

```
fo = open("test.txt","a+")
anim_list = ["cat","tiger","bear","elephant","mouse
    ","dear"]

for animal in anim_list:
    print(animal)
    fo.write(animal+"\n")

fo.close()
```

file: py-file-io.py

Loop in Python

- for-loop

```
#Example of simple loop
import numpy as np
imax = 64
a = np.ndarray(shape=(imax), dtype=float)
for i in range(imax):
        a[i] = 1.0
```

Loop in Python

- Loop with string data.

```
words = ['I', 'me', 'you', 'him']
for w in words:
  print(w, len(w))
```

Loop in Python

- while-loop.

```
i=1
while i<6:
   print(i)
   i +=1

i=1
while i<6:
   print(i)
   if i==4:
      break
   i +=1
```

file: py-while.py

More precise loop in Python

- for-loop for forward-backward sweep.

```
#print precise
for i in range(6,1,-1):
    print("a[%d]=%.4f"%(i,a[i]))

print()
for i in range(1,6):
    print("a[%d]=%.4f"%(i,a[i]))
```

file: py-precise-loop.py

Standard template

- This is a standard template slide.
- Modify by adding items.

Finite difference method for heat equation

- The 1D equation : $\frac{\partial T}{\partial t} = \kappa \frac{\partial^2 T}{\partial x^2}$

```
import numpy as np
from numba import jit , njit
import time

@jit(nopython=True, nogil=True, cache=True)
def theloop(itermax,imax,icenter,coeff,dt,fx,fxnew,peak,tminus):
    for iter in range(itermax):
        for i in range(1,imax):
            fxnew[i] = fx[i] + coeff*( fx[i-1] - 2.0*fx[i] + fx[i+1] )

        peak.append(fxnew[icenter])
        tminus.append((iter+1)*dt)
        fx = fxnew


pi = np.pi
```

Thank You!

Questions?