Programming in Python

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Session-I

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Thiruvananthapuram, Kerala, India 695547

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IEEE Student Branch IIST

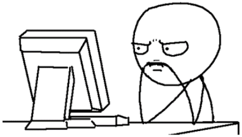
Workshop plan

- **Session-I**
  - Introduction to Python programming language
  - Basic data structures
- **Session-II**
  - Control structures
  - Functions
  - Exception handling
  - File handling
  - Object Oriented Programming in Python
- **Session-III**
  - Introduction to **NumPy**
  - Plotting in Python using **matplotlib**
  - Discussion

Outline for today

As programmers, while coding[1]

It doesn't work...Why?



[1] *Optimates stories - William Yeung's journey to becoming a Graduate Developer Optimation Group.* https://www.optimation.co.nz/news-and-thoughts/optimates-stories-william-yeungs-journey-to-become-our-newest-graduate-developer/. (Accessed on 08/06/2019).

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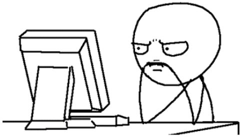
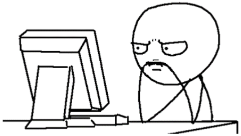


It works...Why?



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Python code to add numbers 2 and 3

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C Equivalent

```
#include<stdio.h>

int main()
{
  printf("%d", 2+3);

  return 0;
}
```

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int main()
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Java Equivalent

```
class Add
{
    public static void main(String
          args[])
    {
        System.out.println(2+3);
    }
}
```

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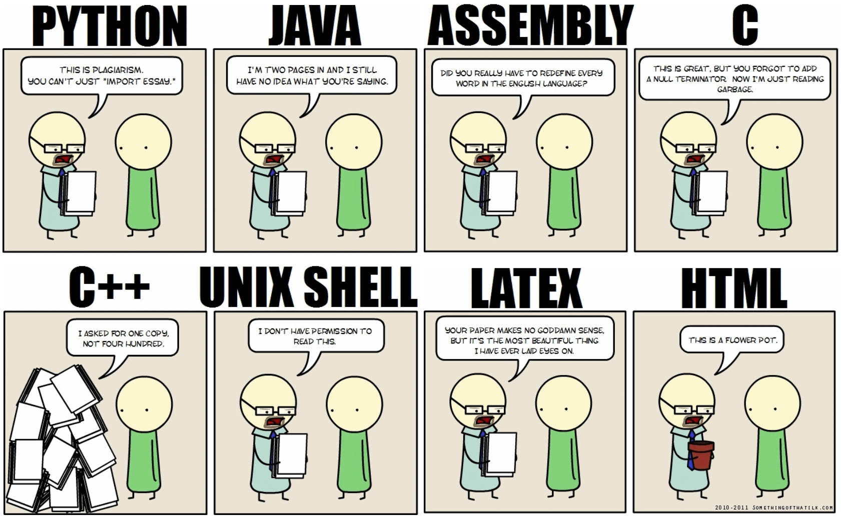
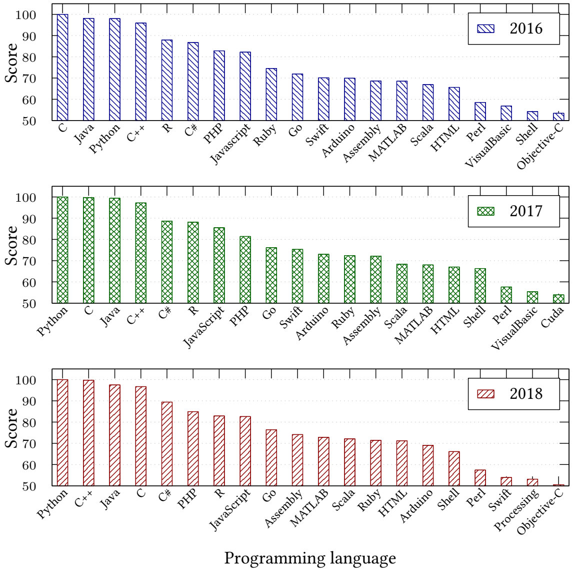
Which is better?

If programming languages were essays[2]


PYTHON
THIS IS PLAGIARISM. YOU CAN'T JUST "IMPORT ESSAY."
JAVA
I'M TWO PAGES IN AND I STILL HAVE NO IDEA WHAT YOU'RE SAYING.
ASSEMBLY
DID YOU REALLY HAVE TO REDEFINE EVERY WORD IN THE ENGLISH LANGUAGE?
C
THIS IS GREAT, BUT YOU FORGOT TO ADD A NULL TERMINATOR. NOW I'M JUST READING GARBAGE.
C++
I ASKED FOR ONE COPY, NOT FOUR HUNDRED.
UNIX SHELL
I DON'T HAVE PERMISSION TO READ THIS.
LATEX
YOUR PAPER MAKES NO GODDAMN SENSE, BUT IT'S THE MOST BEAUTIFUL THING I HAVE EVER LAID EYES ON.
HTML
THIS IS A FLOWER POT.
2010-2011 SOMETHINGOFTHATILK.COM

[2] *If programming languages were essays... : programming.* https://www.reddit.com/r/programming/comments/fqtqk/if_programming_languages_were_essays/. (Accessed on 08/06/2019).

IEEE Spectrum ranking on languages



The Python language

“The joy of coding Python should be in seeing short, concise, readable classes that express a lot of action in a small amount of clear code – not in reams of trivial code that bores the reader to death.”

– Guido van Rossum

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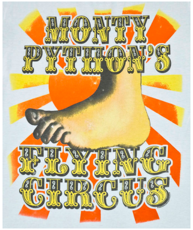
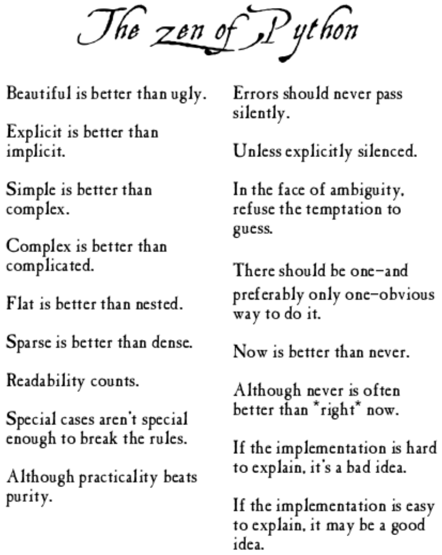
"The joy of coding Python should be in seeing short, concise, readable classes that express a lot of action in a small amount of clear code – not in reams of trivial code that bores the reader to death."

– **Guido van Rossum**

- Designed by **Guido van Rossum** in early 1990s
- Name from *Monty Python's Flying Circus*
- Maintained by Python Software Foundation (PSF)
- Multi-paradigm language
- Licensed under Python Software Foundation Licence
- Latest stable releases: Python 3.7.4 and Python 2.7.16
- Web: www.python.org



Design philosophy



The zen of Python

Beautiful is better than ugly.

Explicit is better than implicit.

Simple is better than complex.

Complex is better than complicated.

Flat is better than nested.

Sparse is better than dense.

Readability counts.

Special cases aren't special enough to break the rules.

Although practicality beats purity.

Errors should never pass silently.

Unless explicitly silenced.

In the face of ambiguity, refuse the temptation to guess.

There should be one–and preferably only one–obvious way to do it.

Now is better than never.

Although never is often better than *right* now.

If the implementation is hard to explain, it's a bad idea.

If the implementation is easy to explain, it may be a good idea.

Features

- Bytecode interpreted language
- Focus on readability
- Support to multiple programming paradigms
  - Structured programming
  - Object oriented programming
  - Aspect oriented programming
- Dynamism in
  - Typing
  - Name resolution
  - Memory management

Python IDEs

‘A’ for ‘Apple’

IDLE

- **I**nteractive **D**eve**L**opment **E**nvironment
- Interactive shell for Python code
- Includes editor for Python scripts
- Developed using Python and *tkinter* package

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>>>
>>> print("hello, world")
```

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```
>>>
>>> print("hello, world")
hello, world
```

Data model

- Python considers data as **objects**
- Object has
  1. Identity
  2. Type
  3. Value

```
>>> a = 2
```

- Objects' identity and type cannot be changed

```
>>> id(a)
18653568
```

```
>>> type(a)
<type 'int'>
```

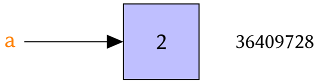
- Two types of objects
  1. **Mutable:** Value can be changed (Ex. list, dictionary)
  2. **Immutable:** Value cannot be changed (Ex. string, tuple, int, float, long)

Memory management

```
>>> a=2
```

Memory management

```
>>> a=2
```



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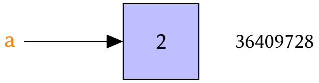

```
>>> b=2
```

Memory management

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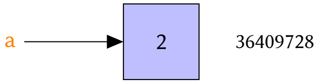

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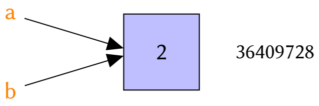

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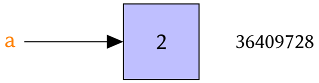

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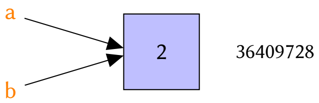

```
>>> a = a + 1
```

Memory management

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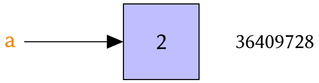

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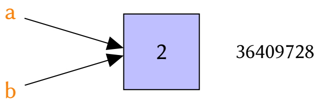

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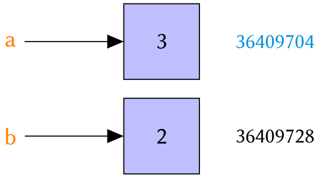

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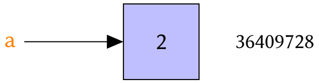

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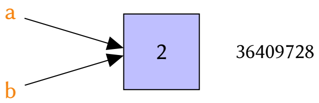

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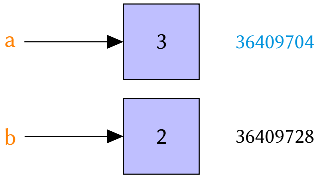

```
>>> b = 5
```

Memory management

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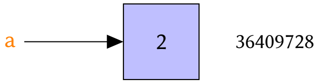

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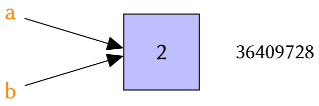

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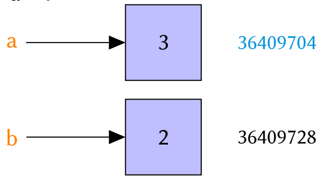

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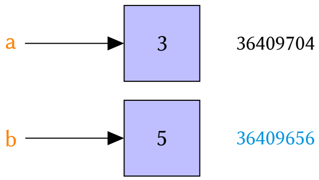

Data types

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     - *Long integers:* Numbers with unlimited range
     - *Boolean:* Truth values (True or False)
  2. *Floating point numbers:* Double precision floating point numbers
  3. *Complex numbers:* Pair of double precision floating point numbers

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- *Sequences:* Finite ordered set of items **indexed by non-negative numbers**
  1. *String:* Items are characters
  2. *Unicode:* Items are Unicode units
  3. *Tuple:* Contains arbitrary python objects
  4. *List:* Contains arbitrary python objects

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  3. *Tuple:* Contains arbitrary python objects
  4. *List:* Contains arbitrary python objects
- *Mappings*
  1. *Dictionary:* Finite objects **indexed by arbitrary index**

Numbers + Operators

```
>>> 2+3
5
>>> 7+3.5
10.5
>>> 5/2
2.5
>>> 2**64
18446744073709551616
>>> 10 % 4
2
>>> 5 // 2.0
2.0
```

Arithmetic operators	
+	Addition
-	Subtraction
*	Multiplication
/	Division
//	Floor division
%	Modulus
**	Exponent

Operators cont'd

```
>>> a = 3
>>> b = 5.3
>>> c = 3
>>> a > b
False
>>> a != b
True
>>> a == c
True
>>> a == c and b > c
True
>>> a != c or b == c
False
>>> a ^ c
0
```

Comparison operators	
<, >	less than, greater than
<=, >=	less than or equal, greater than or equal
==	is equal
!=	Not equal
Relational operators	
and	Logical AND
or	Logical OR
not	Negation
Bitwise operators	
&	Bitwise AND
|	Bitwise OR
^	Bitwise XOR
~	1's complement
<<, >>	Binary left-shift and right-shift

Operators cont'd

```
>>> a = 3
>>> b = 5
>>> c = a + 2
>>> a is b
False
>>> b is c
True
>>> 2 in [1, 2, 3]
True
>>> 'p' in 'world'
False
```

Identity operators	
is	Returns True if **identities** of two objects are equal
is not	Returns True if **identities** of two objects are not equal
Membership operators	
in	Returns True if an item is present in a sequence
not in	Returns True if an item is absent in a sequence

“Python is a truly wonderful language. When somebody comes up with a good idea it takes about 1 minute and five lines to program something that almost does what you want. Then it takes only an hour to extend the script to 300 lines, after which it still does almost what you want.” – **Jack Jansen**

String

- Sequence of characters represented in ASCII
- Immutable

“hello” ⇒

0	1	2	3	4
‘h’	‘e’	‘l’	‘l’	‘o’

Basic Operations

```
>>> a = “hello”
>>> b = “world”
>>> print(a[0])
‘h’

>>> print(b[-1])
‘d’

>>> c = a + b
>>> print(c)
‘helloworld’

>>> a[2] = ‘Z’
>>> d = c[2:5]
>>> print(d)
‘llo’

>>> print(2 * a)
‘hellohello’
```

String Functions

```
>>> p = “ab cb ef”
>>> len(p)
8

>>> q = p.split()
>>> print(q)
[‘ab’, ‘cb’, ‘ef’]
>>> p.split(‘b’)
[‘a ’, ‘ c’, ‘ ef’]

>>> n = ‘hello\n’
>>> n.strip()
‘hello’

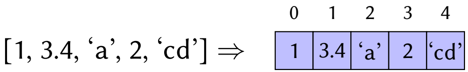
>>> n.strip(‘h’)
ello

>>> n.find(‘o’)
4

>>> str(2.345)
‘2.345’
```

List

- Arbitrary objects separated by comma within [ ]
- Mutable



Basic Operations

```
>>> a = [1, 3.4, 'a', 2, 'cd']
>>> a[2]
>>> a[2:4]
>>> b = a
>>> c = a[:]
>>> print (b)
>>> a[2] = 10
>>> print (a)
>>> print (b)
>>> print (c)
>>> c = c + [9, 10]
>>> print (c)
```

List Functions

```
>>> a.append('pqr')
>>> print (a)
>>> a.reverse()
>>> print (a)
>>> b = [11, 10, 13, 12, 15]
>>> b.sort()
>>> b.remove(10)
>>> b.pop(3)
>>> b.insert(4, 20)
>>> len(a)
>>> max(b)
>>> min(b)
```

Set

- Unordered collection of unique elements
- Elements should be **immutable objects**
- Equivalent to sets in mathematics
- Mutable object

Basic Operations

```
>>> a = {1, 3.4}
>>> type(a)
>>> print(a)
>>> print(a[1])
>>> a.add(4)
>>> print(a)
>>> b = {4, 5, 6}
>>> c = a | b # union
>>> print (c)
>>> d = a & b # intersection
>>> print(d)
>>> a.add((10, 11))
>>> e = a - b # difference
>>> print(e)
>>> e = a ^ b # sym. diff
>>> print(e)
>>> p = [7, 8]
>>> a.add(p)
>>> len(a)
>>> print (a <= b) # subset
>>> print (a >= b) # superset
```

Tuple

- Items are arbitrary objects separated by comma within ( )
- Immutable

```
>>> t = (1, 2, 'hello')
>>> print(t[0])
>>> t[1] = 'world'
>>> p = [0, 1, 2]
>>> u = (4, p)
>>> p.append('hello')
>>> print(u)
>>> z = t + u
>>> print(z)
>>> len(z)
```

Dictionary

- Finite set of objects indexed by arbitrary values
- Items are represented as **key:value** pairs
- Mutable object
- Objects which **cannot** be accepted as keys
  - Mutable types compared by values such as lists and dictionaries
- Uses hashing for efficient memory access

```
>>> d = {‘a’:‘apple’, ‘b’:‘boy’, 1: ‘one’, 2: ‘two’, 3:[3, 4, 5]}
>>> print(d)
{‘a’: ‘apple’, 1: ‘one’, 2: ‘two’, ‘b’: ‘boy’, 3: [3, 4, 5]}
>>> print(d[‘b’])
‘boy’
>>> d[1] = ‘hello’
>>> d[‘p’] = ‘pen’
>>> d[(0, 1)] = ‘key is a tuple’
```

```
>>> d.keys()
>>> d.values()
>>> d[[0, 2]] = “key is a list”
```

Input from keyboard and type casting

input()

- Input numbers from keyboard

```
>>> n = input('Enter the number: ')
Enter the number: 4
>>> print(n)
>>> type(n)
```

Type casting

- Conversion of data of a type to another

```
>>> p = 'hello'
>>> l = list(p)
>>> print(l)
>>> t = tuple(p)
>>> print(t)
>>> a = 10
>>> s = str(a)
>>> type(s)
>>> b = [1, 2, 'abc']
>>> c = str(b)
```

```
>>> s = '3.14'
>>> f = float(s)
>>> int(s)
>>> s = str(a) + ' ' + p + ' ' + str(f)
>>> print(s)
>>> q = '%d %s %f' % (a, p, f)
>>> print(q)
```

Keywords

- Reserved words in the language
- Not advised to use as variable names

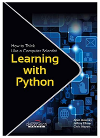
---

and	as	assert	break	exec	is
del	elif	else	except	in try	return
from	global	if	import	raise	def
not	or	pass	print	continue	for
while	with	yield	class	finally	lambda

"In many ways, it's a dull language, borrowing solid old concepts from many other languages & styles: boring syntax, unsurprising semantics, few automatic coercions, etc etc. But that's one of the things I like about Python." – **Tim Peters**

Reference materials

Official Python documentation is available at https://docs.python.org



"How to Think Like a Computer Scientist: Learning with Python 3" - Peter Wentworth, Jeffrey Elkner, Allen Downey, and Chris Meyers

"Dive into Python 3" - Mark Pilgrim

"A Byte of Python" - Swaroop C. H.

Learn Python - tutorialspoint

Thank you.

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