

Hello Python!

Dr. Giuseppe
Maggiore

Introduction

The Python
Programming
Language

Python basic
syntax and
semantics

Hello Python!

Dr. Giuseppe Maggiore

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Rotterdam, Netherlands

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Lecture topics

- We introduce Python
- We bridge what we have seen in the previous lecture with actual Python elements

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Why many programming languages?

- Low-level vs high-level
- Statically-typed vs dynamically-typed
- Compiled vs interpreted
- Imperative vs functional vs logic vs declarative vs object-oriented
- Safe vs unsafe
- Fast vs slow
- ...

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Why many programming languages?

- The set of all problems is a complex, fractal-looking shape
- The programming language we choose shifts our focus on these problems
- Some become more visible and obvious to solve...

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Why many programming languages?

- The set of all problems is a complex, fractal-looking shape
- The programming language we choose shifts our focus on these problems
- Some become more visible and obvious to solve...
- ...others become hidden, obstructed, or harder to solve

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Why many programming languages?

- Not all languages are equal
- There is improvement and an ordering
 - For low-level programming C is in most cases better than assembly
 - For data transformation SQL is in most cases better than Java
 - For algorithmic work on trees F# is in most cases better than C#

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Why many programming languages?

- Not all languages are comparable
- There are perfectly valid differences in balance and features
 - Most languages are better than assembly in most scenarios
 - For data transformation SQL is as good as F# on algorithmic work on trees

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Early programming languages

- Analytical Engine/Difference Engine: hypothetical mechanical computers (1840's, Charles Babbage and Ada Lovelace)
- Assembly language: programming close to the machine (1940's)
- Fortran, ALGOL, and COBOL: various forms of imperative programming (1950's)
- LISP: functional and meta-programming (1950's, still in use)
- Simula: object-oriented programming (1950's)
- C: high-level low-level programming (1970's, still in use)
- Smalltalk: everything-is-an-object programming (1970's)
- Prolog: logic programming (1970's)

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1980's

- C++: C with classes (still in use)
- Matlab and Mathematica: mathematics and simulations (still in use)
- Erlang: concurrency and telecommunications (still in use)

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1990's: the Internet Age

- Haskell: functional programming (still in use)
- Python, Ruby, Lua: concise, dynamic programming (still in use)
- JavaScript: webpage dynamics (still in use)
- Java: objects and portability (still in use)

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2000's: the Modern Age

- C#: objects and portability (still in use)
- F# and Scala: hybrid, functional-first programming and portability (still in use)
- Go and Swift: native, safe development (getting traction?)

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The Python Zen

- Beautiful is better than ugly
- Explicit is better than implicit
- Simple is better than complex
- Complex is better than complicated
- Readability counts

The Python Programming Language

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Python introduction

- General-purpose language
- High-level
- Concise on purpose
- Dynamically typed
- Hybrid paradigm, imperative/procedural first

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Why Python?

- Used a lot as a beginning languages in higher education
- Adequate for expressing the basics of computational thinking
- High signal to noise ratio of syntax

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Variables

- Variables are not declared
- Just initialize and subsequently use

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Variable names

- Variables may begin with any letter or the `_` sign
- Followed by any sequence of letters, numbers, and the `_`

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```
x
y
_x
customer_name
_x1
_x1_customer
```

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Variable names

- Python supports integers and other sorts of numbers
- Any sequence of numeric characters (we call it an integer *literal*) is a number

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100

0

-1

79228162514264337593543950336L

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Variable names

- We can assign a value to a variable
- `variableName = expression`
- What does this do to the memory of the program?

Discuss.

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Variable names

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- What does this do to the memory of the program?

Discuss.

- **If the variable did not exist, then we add it to memory**
- If the variable existed, then we change its value in memory

$$\begin{cases} (PC, S) \xrightarrow{e} (PC + 1, S'[x \mapsto e]) & \text{when } x \in S \wedge S' = S - \{x\} \\ (PC, S) \xrightarrow{e} (PC + 1, S[x \mapsto e]) & \text{when } x \in S \end{cases}$$

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PC

1

```
1 x = 100  
2 y = 200  
3 z = 50
```

what changes while running the current instruction? **Try to guess and discuss!**

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PC

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PC
1

```
1 x = 100
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3 z = 50
```

PC	x
2	100

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PC	x
2	100

```
1 x = 100
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PC	x
2	100

```
1 x = 100  
2 y = 200  
3 z = 50
```

PC	x	y
3	100	200

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PC	x	y
3	100	200

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1 x = 100
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```

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PC	x	y
3	100	200

```
1 x = 100
2 y = 200
3 z = 50
```

PC	x	y	z
4	100	200	50

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PC	x	y	z
1	0	-1	5

```
1 x = 100
2 y = 200
3 z = 50
```

what changes while running the current instruction? **Try to guess and discuss!**

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PC	x	y	z
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PC	x	y	z
3	100	200	5

```
1 x = 100
2 y = 200
3 z = 50
```

PC	x	y	z
4	100	200	5 0

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The best of luck, and thanks for the
attention!