Lecture 01

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to Python
Data in Python
Simple Data
Types
Compound Data
Types
Variables,
expressions and

Introduction to Python

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Overview

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Introduction to Python Data in Python Simple Data Types Compound Dat Types Variables, expressions and

1 Introduction to Python

- Data in Python
- Simple Data Types
- Compound Data Types
- Variables, expressions and statements

Hardware and software

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- Hardware -computers (desktop, mobile, etc) and related devices
- **Software** -programs or systems which run on hardware
- Programming language notation that defines syntax and semantics of programs

What computers do

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Storage and retrieval

- Internal memory
- Hard disk, memory stick
- Operations
 - Processor
- Communication
 - Keyboard, mouse, display
 - Network connector

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- **Python** a high level programming language. It is a great language for beginner programmers!
- **Python interpreter** a program which allow us to run/interpret new programs.
- Python standard library: built-in functions and types

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Python is:

- A modern programming language
- Simple to write and understand
- An interpreted language
- A garbage collected language
- A language that support multiple paradigms: structured, object-oriented, functional and aspect oriented programming are all on the menu!
- A language with great support and many available libraries

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Python is...

Simple to write and understand

```
myList = []
while True:
    x = int(input("Enter item (-1 to finish):"))
    if x == -1:
        break
    myList.append(x)
return myList
```

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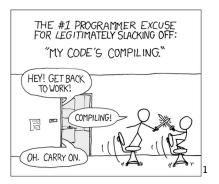
– Lect. PhD. Arthur Molnai

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Python is...

An interpreted language



¹https://xkcd.com/303/

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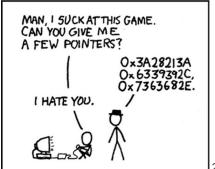
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Python is...

A garbage collected language



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Python mantra³:

- Beautiful is better than ugly
- Explicit is better than implicit
- Simple is better than complex
- Flat is better than nested
- Sparse is better than dense
- Readability counts

Basic elements of a Python program

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- Lexical elements a Python program is divided into a number of lines.
- Comments start with a hash (#) character and ends at the end of the line.
- **Identifiers** (or **names**) are sequences of characters which start with a letter (a..z, A..Z) or an underscore (_) followed by zero or more letters, underscores, and digits (0..9).
- Literals are notations for constant values of some built-in types.

Demo

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Basic elements of a Python program

 $ex01_BasicSyntax.py$

Data vs. Information

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- Data collection of symbols stored in a computer (e.g. 123 decimal number or 'abc' string are stored using binary representations)
- **Information** interpretation of data for human purposes (e.g. 123, 'abc')

Python data model

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Introduction to Python Data in Python Simple Data Types Compound Data Types Variables, expressions and statements **All data** in Python programs is represented by objects, an **object** being Python's abstraction for data.

An **object** has:

- an identity we may think of of it as the object's address in memory.
- a type which determines the operations that the object supports and also defines the possible values.
- a value.

Types

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- **Types** classify values. A type denotes a **domain** (a set of possible values) and **operations** on those values.
- **Numbers** are immutable, so once created, their values cannot be changed.

Identity, value and type

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Recall what is a name and an object (identity, type, value).

- mutable objects: lists, dictionaries, sets
- immutable: numbers, strings, tuples

We determine the identity and the type of an object using the built-in functions:

- id(object)
- type(object), isinstance(object, type)

Standard types in Python (1/3)

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int⁴:

 Represents the mathematical set of integers (positive and negative, unlimited precision)

bool:

■ Represents the the truth values True and False.

float:

Represents the mathematical set of double precision floating point numbers.

⁴https://docs.python.org/3/library/stdtypes:html → ⟨ ≥ →

Standard types in Python (2/3)

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Sequence types⁵

- Finite ordered sets indexed by non-negative numbers
- Let a be a sequence.
 - len(a) returns the number of items
 - a[0], a[1], ..., a[len(a)-1] represent the set of items
- Examples: [1, 'a']

string

- A string is an immutable sequence
- The items of a string are Unicode characters

⁵https://docs.python.org/3/library/stdtypes.html#sequence-types-list-tuple-range

Standard types in Python (3/3)

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list⁶

- Mutable sequence of elements
- Typically used to store collections of homogeneous items
- Every item has a predecessor and successor

tuple⁷

- Immutable sequence
- Typically used to store collections of homogeneous items

dict⁸

Mapping between unique keys and values

⁶https://docs.python.org/3/library/stdtypes.html#list

⁷https://docs.python.org/3/library/stdtypes.html#tuple

^{*}https://docs.python.org/3/library/stdtypes.html#dict: > < ? > ? < ?

List

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Data in Python Simple Data Types Compound Data Types Variables, expressions and **Lists** represent finite ordered sets indexed by non-negative numbers.

Operations:

- Creation
- Accessing values (index, len), changing values (lists are mutable)
- Removing items (pop), inserting items (insert)
- Slicing
- Nesting
- Generate list using range(), list in a for loop
- Lists as stacks (append, pop)

Tuple

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- Packing values (creation)
- Nesting
- Empty tuple
- Tuple with one item
- Sequence unpacking

Dictionary

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A **dictionary** is an unordered set of (key, value) pairs with unique keys. The keys must be immutable. Operations:

- Creation
- Getting the value associated to a given key
- Adding/updating a (key, value) pair
- Removing an existing (key, value) pair
- Checking whether a key exists

Demo

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Basic compound types

 $ex02_BasicCompoundTypes.py$

Variables and expressions

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NB!

Variables are reserved memory locations to store values

- A variable has:
 - Name
 - Type
 - Domain
 - Operations

A variable is introduced in a program using a name binding operation - assignment.

Variables and expressions

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Variables. expressions and **Expression** - a combination of explicit *values*, *constants*, variables, operators, and functions that are interpreted according to the particular rules of precedence, which computes and then *produces/returns* another value.

Examples:

numeric expression: 1 + 2

■ boolean expression 1 < 2</p>

string expression: '1' + '2'

Statements

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NB!

Statements are the basic operations of a program. A program is a sequence of statements

Statements

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Assignment

- Assignments are used to (re)bind names to values
- Bind name:
 - $\mathbf{x} = 1$ #is a variable (of type int)
- Rebind name:
 - $\mathbf{x} = \mathbf{x} + 2 \# a$ new value is assigned to \mathbf{x}
- Rebind name of mutable sequences:
 - y = [1, 2] # mutable sequence
 - y[0] = -1 #the first item is bound to -1

Block

- A block is a section of a program that is executed as a unit
- A sequence of statements is a block
- Blocks of code are denoted by line indentation

Demo

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Variables, expressions and statements Controlling program flow

 $ex03_ProgramFlow.py$