

Lecture 01

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Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

Introduction to Python

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Overview

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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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Python is...

An **interpreted** language



¹<https://xkcd.com/303/>

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Python is...

A **garbage collected** language



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²<https://xkcd.com/138/>

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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

³<https://www.python.org/dev/peps/pep-0020/> 

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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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 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.

⁴<https://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.
 - $\text{len}(a)$ returns the number of items
 - $a[0], a[1], \dots, a[\text{len}(a)-1]$ represent the set of items
- Examples: $[1, 'a']$

string

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

⁵<https://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

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

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

⁸<https://docs.python.org/3/library/stdtypes.html#dict> 

List

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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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Tuples are immutable sequences. A **tuple** consists of a number of values separated by commas.

Operations:

- 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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- **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 $1 < 2$
 - 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:

- $x = 1$ *#is a variable (of type int)*

- Rebind name:

- $x = x + 2$ *#a new value is assigned to 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

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Controlling program flow

ex03_ProgramFlow.py