

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

Introduction to Python

Lect. PhD. Arthur Molnar

Babes-Bolyai University

Overview

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

1 Introduction to Python

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

Hardware and software

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

- **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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

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

Python 101

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

- **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

Python 101

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

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

Python 101

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

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
```

Python 101

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

Python is...

An **interpreted** language



¹<https://xkcd.com/303/>

Python 101

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

Python is...

A **garbage collected** language



2

²<https://xkcd.com/138/>

Python 101

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

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/>

What do you need?

Lecture 01

Lect. PhD.
Arthur Molnar


Introduction to Python

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

- 1 Python 3
- 2 GitHub Desktop (**OR** use git in command line, **OR** git integration with IDEs)
- 3 An IDE (Eclipse + PyDev **OR** VS Code **OR** PyCharm)

OR

- 1 Use the PythonBox - a virtual machine we've prepared as a backup solution for the exam, which you can also use from home⁴

⁴<http://www.cs.ubbcluj.ro/~arthur/PythonBox/> 

Basic elements of a Python program

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

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

- **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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

Basic elements of a Python program

ex01_BasicSyntax.py

Data vs. Information

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

- **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

Lecture 01

Lect. PhD.
Arthur Molnar

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 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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

- **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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python
Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

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)

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

int⁵:


- 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.

⁵<https://docs.python.org/3/library/stdtypes.html> 

Standard types in Python (2/3)

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python
Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

Sequence types⁶

- 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

⁶<https://docs.python.org/3/library/stdtypes.html#sequence-types-list-tuple-range>

Standard types in Python (3/3)

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

list⁷

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

tuple⁸

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

dict⁹

- Mapping between unique keys and values

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

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

⁹<https://docs.python.org/3/library/stdtypes.html#dict>

Demo

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python
Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

Basic compound types

ex02_BasicCompoundTypes.py

List

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python
Simple Data
Types

Compound Data
Types
Variables,
expressions and
statements

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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

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

Variables and expressions

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

- **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

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python
Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

NB!

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

Statements

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python

Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

■ 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

Demo

Lecture 01

Lect. PhD.
Arthur Molnar

Introduction
to Python

Data in Python
Simple Data
Types

Compound Data
Types

Variables,
expressions and
statements

Controlling program flow

ex03_ProgramFlow.py