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O Object
O Oriented
P Programming

S1 = Python with Bianca

S2 = Java with Bryan

DT228(TU856)/DT282(TU858) - 2

OLLSCOIL TEICNEOLAÍOCHTA BHAILE ÁTHA CLIATH
TU DUBLIN
TECHNOLOGICAL UNIVERSITY DUBLIN

COMPUTER SCIENCE

Week 2
Python Language Foundations

Objectives

- Discuss differences in programming paradigms
- Revise variable usage
- Use the different Python data types

Transition from one Language to Another

- At varying times in your career you will be required to change languages
  - Our industry moves quickly
- Picking up a new language quickly is a valuable skill that we will practice in this course
  - Picking up the syntax is relatively easy
  - You can learn enough to be ‘dangerous’ in one week
  - Proficiency relies on you mastering the aspects of the new language that the previous one didn’t provide
  - Make your code look “Pythonic” rather than C written in Python!

Comparison POP and OOP

POP

- Top down approach
- Records
- Procedure
- Module
- Program execution is main concern during design phase
  - Intuitive design
- Breaks a problem or task down into smaller sub-tasks and routines
- Difficult to maintain when changes are implemented

OOP

- Modular approach
- Object
  - Basic unit of OOP
- Method
  - Methods are part of an object
- Class
- Recycling/Reusing of code
- Design strong connection with UML
- Typically allows for more complicated programs while using less code
- Considered better for security applications

Python **Dynamic** Typing

Static (Java, C++)

- Variable doesn't need to be defined before used
- Static has to do with the **explicit** initialisation or declaration of a variable
- Variable needs to be initialized before used

Dynamic (Python)

- Variable must be defined before used
- Does **not** require **explicit** declaration of variable.

Example of Dynamic Typing

Static declaration in C

```
int num, sum;
// explicit declaration num = 5;
// now use the variables
Num = 5;
sum = 100;
sum = sum + num;
```

Dynamic declaration in Python

```
Num = 100
// directly declared and used
```

- Can you think of pros and cons with dynamic typing?

Comparing Python to Python

Pythonish

```
i = 0
while i < len(myItems):
print(myItems.get(i)) i += 1
```

Pythonic

```
for item in my_items:
print(item)
```

Revision on variables

- Names given to data
- Store information
- Also for manipulation of information
- Examples:
  - Age of a person: `user_age = 30`
  - Name of a person: `user_name = 'Bianca'`
  - Or `user_age, user_name = 30, 'Bianca'`

Naming Variables

- Allowed are only certain letters
  - a-z and A-Z
- Numbers
- Underscores `_`
- First character cannot be a number
  - `user_name`
  - `user_name2`
  - **NOT** `2user_Name`
- Cannot use reserved names, for example print, if, else, while
- Case sensitive userName and UserName are not the same

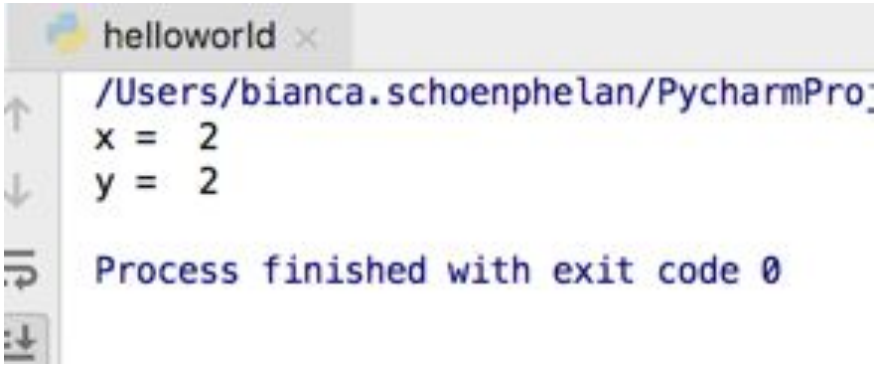
Two conventions:
- Camel Case: `myName`
- Underscore: `my_name`

Underscore is recommended in Python!

Assigning Values to Variables

- Using the assignment operator =

```
x = 3
y = 2
x = y
print (“x = “, x)
print (“y=“ , y)
```



Basic Operators

Symbol	Operation	Example x=5, y=2	Result
+	Addition	x + y	7
-	Subtraction	x - y	3
*	Multiplication	x * y	10
/	Division	x / y	2.5
//	Floor division	x // y	2
%	Modulo	x % y	1
**	Exponent	x ** y	25

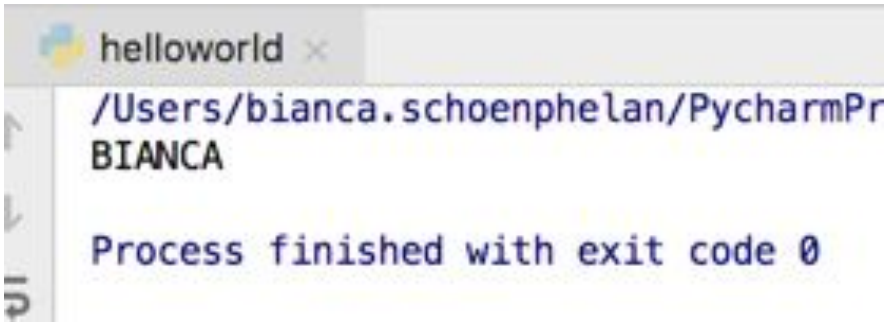
- More operators:
  - +=
  - -=
  - *=

Python doesn't do `++` or `--`

Data Types

Data Types

- Integer, example: `user_age = 30`
- Float, example: `user_height = 1.55`
- String, example: `user_name = 'Bianca', user_age = '30'`
  - Many built in functions for String operations, example: `print('Bianca'.UPPER)`



Data Types: String

- String

  `variable_name = 'initial Value'` or

  `variable_name = "initial Value"`
- We can concatenate substrings with +
- Example:

```
my_name = 'Bianca'
conjunction = 'and'
his_name = 'Don'
print(my_name+conjunction+his_name)
```

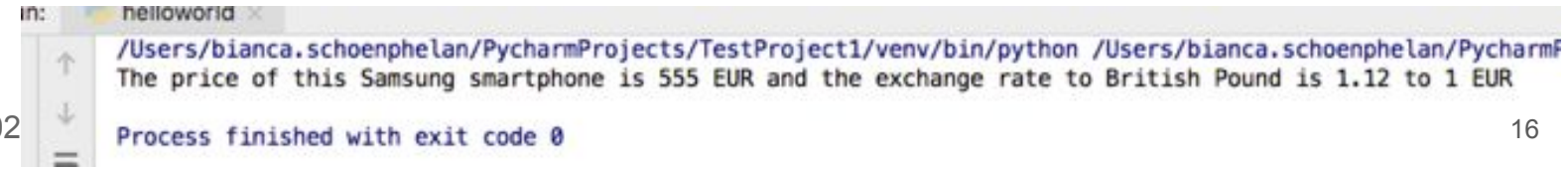
Strings are considered immutable. What does that mean?

Formatting Strings with %

- We can change the look of a String by manipulating the output with the % operator
- `"string to be formatted" % (values or variable to be inserted to string, separated by comma)`
  - There are 3 parts to this operation
  - Round bracket part to the operation is known as a tuple
- Example:

Placeholder

```
message = ("The price of this %s smartphone is %d EUR and the exchange rate to British Pound is %4.2f to 1 EUR" % (brand, 555, exchange_rate)
```



Placeholders and Formatters

- Placeholders will be replaced with values
- %s formatter represents a string
- %d formatter represents an integer
  - We can include spaces in the representation with giving a number of spaces
  - Example: `print("%10d"%(12))`

Formatters

- %f formats decimal numbers, example uses 4.2f:
  - 4 = total length
  - 2 = decimal positions
  - What does the following do:

```
print("%7.2f"%(1.123))
```

[6]

format() method

format() is a newer way of formatting strings

- “string to be formatted”.format(values or variables to be inserted into string, separated by comma)
- No more %s %d %f for placeholders, but now {}
- Example:

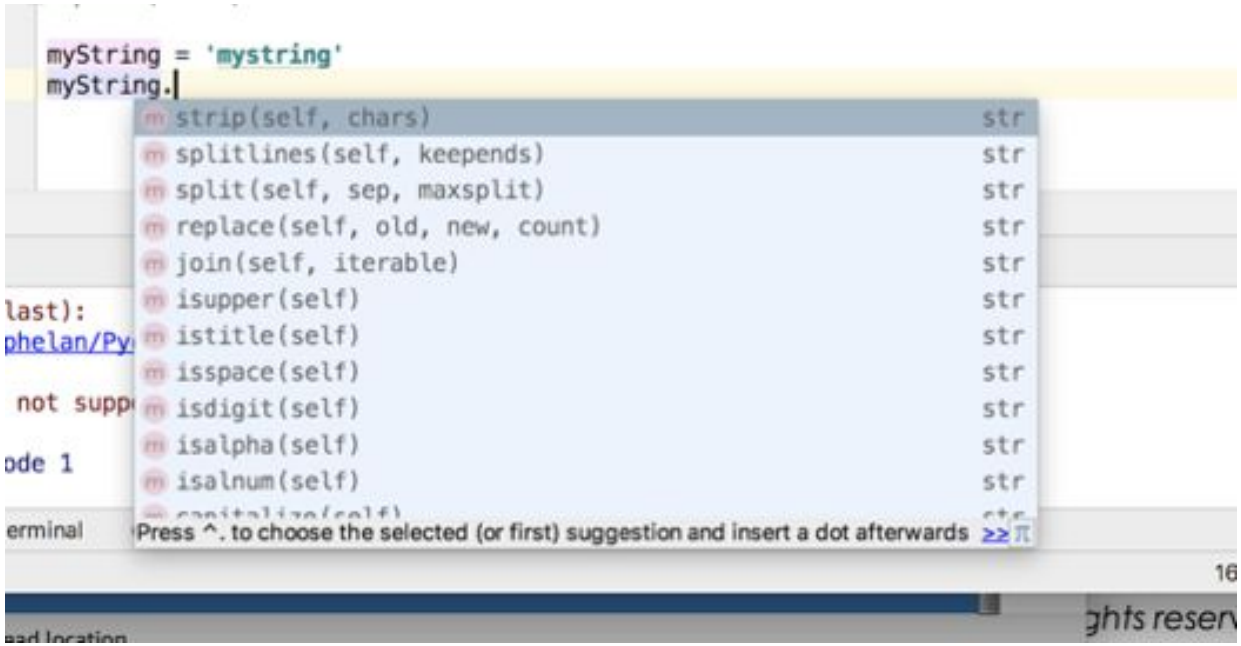
```
$ message = "The price of this {0:s} smartphone is {1:d} EUR and the exchange rate to British Pound is {2:4.2f} to 1 EUR".format(brand, 555, exchange_rate)
$ print(message)
```

```
helloworld
/Users/bianca.schoenphelan/PycharmProjects/TestProject1/venv/bin/python /Users/bianca.schoenphelan/PycharmProje
The price of this Samsung smartphone is 555 EUR and the exchange rate to British Pound is 1.12 to 1 EUR

Process finished with exit code 0
```

String functions

There are many string functions available



Some examples: count

- `count(sub,[start,[end]])`
  - Start and end are optional parameters
  - Return the number of times the substring sub appears in a string
  - Function is case sensitive
- What does the following do:

```
1. print('this is a string'.count('s'))
2. print('this is a string'.count('s',4))
3. print('this is a string'.count('s',4, 10))
4. print('This is a string'.count('T'))
```

More examples: endswith

- `endswith(suffix,[start,[end]])`
  - Returns true if the string ends with a specified suffix, otherwise returns false
  - Suffix can also be a tuple of suffixes
  - Function is case sensitive
- What does the following do:

```
1. print('Postman'.endswith('man'))
2. print('Postman'.endswith('man', 3))
3. print('Postman'.endswith('man', 2, 6))
4. print('Postman'.endswith('man', 2, 7))
```

String examples: find/index

- `find/index(sub,[start,[end]])`
  - Returns the index in a string, where the **first occurrence** of the substring is found
  - `find()` returns -1 if sub not found
  - `index()` returns ValueError if sub not found
- What does the following do:

1. `print('This is a string'.find('s'))`
2. `print('This is a string'.find('s',4))`
3. `print('This is a string'.find('s',7,11))`
4. `print('This is a string'.find('o'))`
5. `print('This is a string'.index('o'))`

More string functions

Alphanumeric is either a letter or a number.

- `isalnum()`
  - Returns true if all characters in a string are alphanumeric, and there is at least one character (false or otherwise)
  - Does not include whitespaces
- What does the following do:

1. `print('abc123'.isalnum())`
2. `print('a b c 1 2 3'.isalnum())`
3. `print('abc'.isalnum())`
4. `print('123'.isalnum())`

More string functions cont'd

- `isalpha()`
  - Returns true if all characters in the string are alphabetic and there is at least one character (true or otherwise)
- What does the following do:

1. `print('abc'.isalpha())`
2. `print('abc123'.isalpha())`
3. `print('123'.isalpha())`
4. `print('a b c'.isalpha())`

More string functions cont'd

- `isdigit()`
  - Returns true if all characters in the string are digits, and there is at least one character (true or otherwise)
- What does the following do:

1. `print('123'.isdigit())`
2. `print('123abc'.isdigit())`
3. `print('abc'.isdigit())`
4. `print('1 2 3'.isdigit())`

isnumeric is TRUE if we feed it a digit from any language Python recognises.

```
>>> print('二'.isdigit())
False
>>> print('二'.isnumeric())
True
```

All decimals are digits, but not all digits are decimals.

Similar functions

- `islower()`
- `isspace()`
- `istitle()`
- `isupper()`

Working with many strings

- `join()`
  - Returns a string where the parameter provided is joined by a separator
- What does the following do:

```
seperator ='-'
my_tuple = ('a', 'b', 'c')
my_list = ['d', 'e', 'f']
my_string = "Hello World"

print(seperator.join(my_tuple))
print(seperator.join(my_list))
print(seperator.join(my_string))
```

Working with many strings cont'd

- `replace(old,new[,count])`
  - Returns a copy of a string with all occurrences of substring old replaced by substring new
  - Count is options, means that only these amount of instances are replaced
  - The function is case sensitive
- What does the following do:

```
1.print('This is a string'.replace('s','p'))
2.print('This is a string'.replace('s','p',2))
```

Working with strings

- `split([sep,[maxsplit]])`
  - Returns a list of words in a string
  - If sep is not given, use whitespace
  - If maxsplit is given, this is the maximum number of splits performed
  - Function is case sensitive
- What does the following do:

1. `print('This, is, a, string'.split(','))`
2. `print('This is a string'.split())`
3. `print('This, is, a, string'.split(',',2))`

More strings

- `splitlines([keepends])`
  - Returns a list of lines, break at boundary
  - Linebreaks are not included unless keepends is used and true
- What does the following do:

1. `print("This is the first line. \nThis is the second line.".splitlines())`
2. `print("This is the first line."`
   `"This is the second line.".splitlines())`
3. `print("This is the first line. \nThis is the second line.".splitlines(True))`

Non printing characters

- Can be inserted directly into a string
  - New line: \n
  - Tab: \t
- Apostrophes in Names need to be escaped
  - Example: O\’Brien

Last of the string functions for today

- `strip([chars])`
  - Returns a copy of a string with the leading and trailing characters char removed
  - If char is not provided, the function uses whitespaces
- What does the following do:

1. `print("      This is a string ".strip())`
2. `print("This is a string".strip('s'))`
3. `print("This is a string".strip('g'))`

Strings and integers

```
>>> a = 5
>>> a
5
>>> a + 7
12
>>> a = "Hello!"
>>> a
'Hello!'
>>> a + 7
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: can only concatenate str (not "int") to str
>>> a + " Good Morning!"
'Hello! Good Morning!'
```

a is now an *int*

can do basic arithmetics

a is now a *string*

can do string concatenation

Data Types: List

- Zero-indexed
- Guarantees order or items

List: collection of data which are normally related, can be different data types

```
list_name = [initial values]
user_age = [10, 20, 30, 40, 50, 60, 70], or
user_age = []
```

This is an empty list. Add items using append() method

- Individual items can be accessed by an index that starts with 0 (never with 1)
  - Last item in the list has the index -1, second last -2, etc
  - user_age[-1] will return 70
- Can be assigned to a variable:

```
user_age2 = user_age
user_age3 = user_age[1:3]
user_age4 = user_age[1:6:2]
```

So called **slice** notation:
Item at the start is always ***included***, item at the end is always ***excluded***. Third number is a stepper (every 2nd item) in range.

Slices

```
user_age = [10, 20, 30, 40, 50, 60, 70]
```

- Useful defaults:
  - First number is 0, example: `user_age [ :4]` returns values from 0 to 4-1
  - `user_age[1: ]` returns values from index 1 to length-1

Working with Lists

- Modify by assigning new value to an index

  `user_age[3] = 99 results in`

  `user_age = [10, 20, 30, 99, 50, 60, 70]`

  - Add an item with append()
  - `user_age.append(100)` results in

    `user_age = [10, 20, 30, 99, 50, 60, 70, 100]`

- Remove an item with del
  - `Del user_age[3]` results in

    `user_age = [10, 20, 30, 50, 60, 70, 100]`

Working with Lists

```
my_list = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h',
'i', 'j']
    1.del my_list[2]
    print(my_list)
    2.del my_list[1:5]
    print(my_list)
    3.del my_list[:3]
    print(my_list)
    4.del my_list[2:]
    print(my_list)
```

Extending lists

- `extend()`
  - Combine two lists
- What does the following do:

```
my_list1 = ['a', 'b', 'c']
my_list2 = [1, 2, 3]
my_list1.extend(my_list2)
print(my_list1)
```

Working with lists

- `in`
  - True if the parameter is in the list, false otherwise
  - print('c' in my_list1) returns true
- `insert()`
  - Add an item at a particular position
- `len()`
  - Number of items

No brackets

Working with Lists cont'd

- `pop()`
  - Get an item at an index position and remove it from the list
- Example:

```
my_list1 = ['a', 'b', 'c']
member = my_list1.pop(2)
print(member)
print(my_list1)
```

Removes the last item on the list if no argument is given.

Working with lists

- `remove()`
  - Removes an item from a list and requires a specific value
- Example:

```
my_list1 = ['a', 'b', 'c']
my_list1.remove('a')
print(my_list1)
```

Removes the last item on the list if no argument is given.

So what's the difference?

- What is the difference between del, pop and remove?
  - `remove`: removes first matching value from the List (not a specific index location)
  - `del`: removes an item at a specific index location
  - `pop`: Removes an item at a specific index location and returns it

Sorting lists

- `reverse`
- `sort`
- `sorted(...)`
  - Returns a new sorted list without changing the original list

Operators and Lists

- + operator to concatenate

```
my_list1 = ['a', 'b', 'c']
my_list2 = [1, 2, 3]
print(my_list1+my_list2)
```

- * operator to multiply

```
print(my_list1*3)
```

Data Types: Tuples

- **Tuples**: like lists, but values cannot be changed

```
tuple_name = (values)
```

```
months_of_the_year = ('Jan', 'Feb', 'Mar')
```

- Individual values can be accessed through indexes, like we did with lists
- Delete a complete tuple with del

```
del months_of_the_year
```

```
print (months_of_the_year)
```

Will produce and error if the variable name is not defined!

- Indexes can be used the same way as with lists

Working with Tuples

- `del`: deletes the whole tuple
- `in`: “a” in myTuple -> True
- `len()`
- `+` concatenates tuples
- `*` multiplies tuples

The tuple itself does not get modified.

Data Types: Sets

- Similar and hugely different
- Cannot contain duplicates
- Can contain mixture of types
- Are unordered!
- Example:

```
hello = set('hello')
print(hello)
-> {'l', 'h', 'e', 'o'}
```

Data Types: Dictionary

- **Dictionary**: collection of related data PAIRS

```
dictionary_name = {dictionaryKey : data}
```

```
customers = {"Bianca":30, "Brian":31, "Susan":32}
```

  - Dictionary key must be unique, error when you try

```
customers = {"Bianca":30, "Brian":31, "Bianca":21}
```

- Different python versions will behave differently here and ask you to use a constructor instead

- Dictionaries are collections, but they are not sequences
  - There is no order
  - The order might change if the elements in the dictionary change

Working with Dictionaries

```
print(users_and_age["Bianca"])
```

30

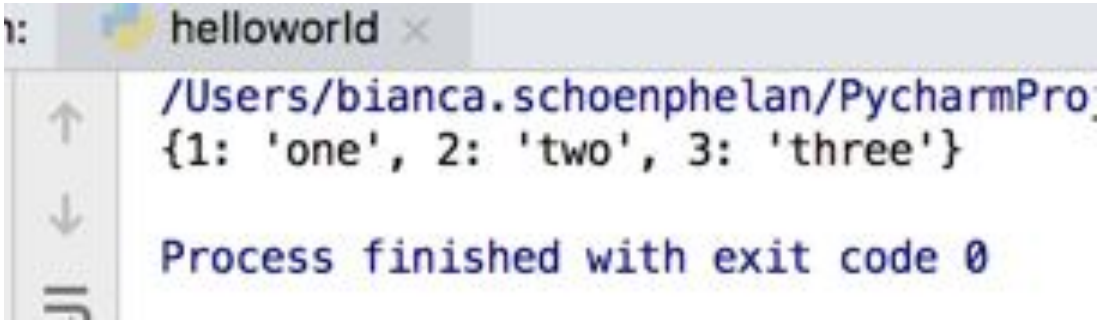
- Modify: `users_and_age["Bianca"] = 51`
- Remove: `del users_and_age["Bianca"]`
- Empty: `users_and_age.clear()`
- `get()`: returns a value for a given key
- `in`: check if an item is in the dictionary
- `items()`: returns a list of dictionary pairs as tuples
- `print(users_and_age.items())`

```
dict_items([('Bianca', 30), ('Brian', 40),
('Susan', 50), ('Lana', 'Not Available')])
```

Working with Dictionaries

- `keys()`: returns a list of dictionary keys
- `values()`: returns a list of dictionary values
- `len()`: number of items in dictionary
- `update()`
- Example:

```
dict1 = {1: 'one', 2:'two'}
dict2 = {1: 'one', 3:'three'}
dict1.update(dict2)
print(dict1)
```



Type Casting

- When we convert a variable's data type from one data type to another we talk about **type casting**
- Python offers 3 built in functions for type casting:
  - `int()`: takes a float or appropriate string and converts it into an integer
  - `float()`: takes an integer or an appropriate string and converts it into a float
  - `str()`: converts an integer or a float into a string

Summary

- ★ Basic Data Types
- ★ Advanced Data Types
- ★ Working with the types
- ★ Casting

References

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