Python For The Digital Humanities

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Contents

Chapter 1

Introduction

1.1 Why Python?

In recent years, the digital revolution has increasingly affected and transformed the humanities. There are now a variety of fields and software that are relevant to us and in which we can work. Maybe you are working with a database, maybe you are creating a digital edition or maybe you are working with artificial intelligence. **Whatever your field, Python can help.**

Figure 1.1: `https://clipground.com/images/wegweiser-clipart-1.jpg` (CC BY 4.0 Deed)

Python...

- is one of the world's most popular programming languages.
- is a High-level programming language.
- is simple and efficient.
- has many, many modules for almost any purpose you can imagine.
- can do all kinds of time-consuming, repetitive work for you.

Overall Python is easy to learn, flexible and efficient.

1.2 Helpful Tutorials and Websites

Websites

- `https://wiki.python.org/`
- `https://www.w3schools.com/python/`
- `https://www.geeksforgeeks.org/python-if-else/`
- `https://automatetheboringstuff.com/`

Youtube tutorials

- `https://www.youtube.com/watch?v=_uQrJ0TkZlc`
- `https://www.youtube.com/watch?v=qwAFL1597eM`

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1.3 How to use this reader

I originally designed this course for the STUDIOLO Winter School 2024. Its aim is to introduce humanities scholars with no prior knowledge to the basics of Python and demonstrate typical applications in the humanities, such as extracting and visualising information from texts. By the end of 2025, I had adapted the course materials to enable self-study.
This reader is split into two parts. The first part introduces the fundamentals of Python, while the second part provides a list of essential tools for working with texts in the field of digital humanities. It also provides references and links to further materials and websites for self-study. So you should have enough material to proceed directly with programming.
While the reader can be worked through independently, it is best used alongside the *BasicPython.ipynb* and *PracticalProject.ipynb* files. *BasicPython* contains sample scripts and exercises to accompany and supplement the reader. *PracticalProject* uses H. P. Lovecraft's novel *At the Mountains of Madness* as an example to demonstrate how to extract and visualise information from texts.

Copyright Notes

The text of the novel 'Mountains of Madness' comes from the Gutenberg Project (`https://www.gutenberg.org/ebooks/70652`). The text has been split into two parts 'Copyright.txt' and 'Mainpart.txt'. Please note the copyright!

Figure 1.2: `https://clipground.com/images/coder-clipart-1.jpg` (CC BY 4.0 Deed)

Chapter 2

Python Basics

2.1 Our environment

I recommend uploading the .ipynb files to Google Colab (`https://colab.research.google.com/`) and editing them there. It allows us to code directly in the browser and eliminates the need for any installations. You will need a Google account to do this. You will also need to upload the .txt files for *PracticalProject.ipynb* there.

Recommendations for working with Google Colab:

- Tutorial: `https://www.tutorialspoint.com/google_colab/index.htm`
- Change the editor so that line numbers are displayed. This way it is easier to find errors (Tools > Settings > Editor > show line numbers).
- Google Colab does not permanently store files. To keep your files, download them or save them to Google Drive `https://www.tutorialspoint.com/google_colab/google_colab_saving_work.htm`.
- If (unintended) errors occur when executing individual scripts, please click the *Run all* button, which can be found either at the top of the menu bar or in the *Runtime* > *Run all* tab. This will execute all scripts in the correct order. This helps to avoid errors that may occur if the session has been inactive for too long, for example, or if a script accesses variables that have not been set previously.
- If this does not work, you can try to restart a session (Runtime > Restart Session).

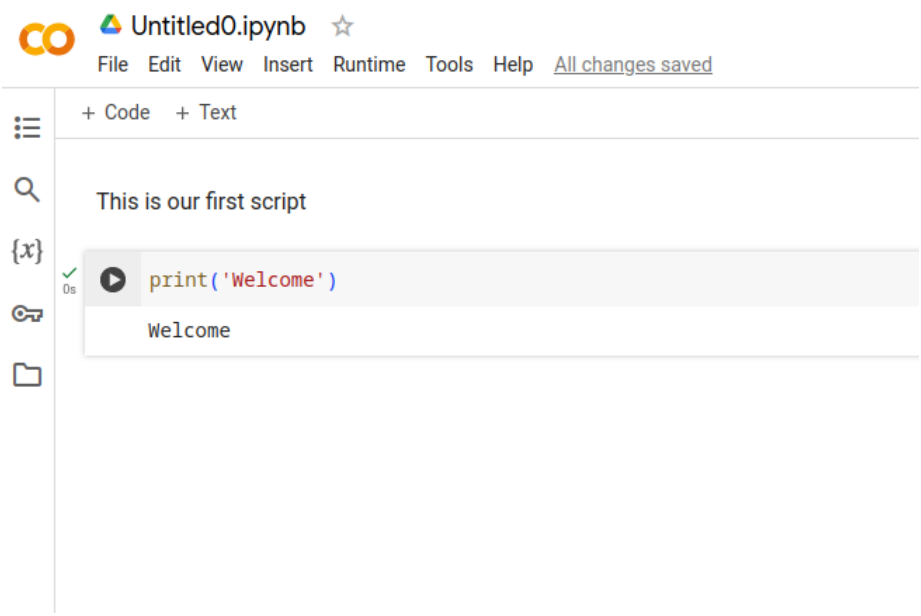

Figure 2.1: Google Colab

2.2 Comments

A *comment* is text that is ignored by the interpreter. It starts with a hashtag. In your editor, comments look like this:

```
# This is a comment
```

Why you should use comments

- Use comments to explain your code
- Use comments to structure your code
- Comments allow you to (temporarily) disable parts of your code. This is a great help when debugging (i.e. searching for errors).

Multiline comments

You can define multiple lines as a comment by enclosing them in three quotation marks (either single or double quotation marks).

```
'''This
is
a
multiline
comment'''
```

```
6
7  """This
8  is
9  a multiline
10 comment
11 as
12 well"""
```

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2.3 The print function

You can use the *print function* to display text. Just type the word "print" and then type the text you want to display in parentheses and quotation marks. You can use either single or double quotes.

```
1  # The print command using single quotation marks
2  print('Hello')
3
4  # The print function using double quotation marks
5  print("Hello")
```

If you want to display a number, you don't need quotation marks.

```
1  print(7)
```

This is because numbers are interpreted as a different data type, as we will see later (see 2.6).

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2.4 Arithmetic Operators

When it comes to coding, we need to do at least some mathematical operations. In this workshop, we will use only the four basic arithmetic operators you learned in elementary school:

- Addition: +
- Subtraction: -
- Multiplication: *
- Division: /

For further arithmetic operators (like Modulus), see the section "Furher References".

Arithmetic Operators and numbers

Using the print function we can perform all kinds of mathematical operations and display the results. Here are some examples:

```
print(7+2)
print(7-4+3-1+27)
print(2*2)
print(6/2)
```

Concatenating words or texts

We can use the "+" operator to concatenate words/texts (this can be an important tool if, for example, you want to automatically replace certain parts of a text):

```
print('Hi' + ' ' + 'there' + '.')
```

The output would be:

```
Hi there.
```

Further References

- https://www.w3schools.com/python/gloss_python_arithmetic_operators.asp
- https://www.geeksforgeeks.org/python-arithmetic-operators/

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2.5 Variables

Variables are like containers that can store different types of information (such as numbers or text) for you. In Python you declare variables by writing the name of the variable, an equal sign, and the value you want to assign to it. You can then access the variable in other functions (such as the print function):

```
# We assign the value 7 to the variable a.
# We do not need quotes, because 7 is a number
a = 7

# We assign the value 'Hi' to the variable b.
# We need quotes, because 'Hi' is a word / text
b = 'Hi'

print(a)
print(b)
```

The output would be:

```
7
Hi
```

You can name variables anything you like. You can even combine letters and numbers, but variables cannot begin with a number. It is also recommended to avoid special characters. So you could name a variable "RogueOne", "Rogue1", but not "1Rogue".

Changing Variables

You can change variables any time. Note how the interpreter reads line by line:

```
# We assign the value 7 to the variable a and display it.
a = 7
print(a)
```

```
4
5  # Now we assign another value to the variable a and display it.
6  a = 9
7  print(a)
```

The output would be:

```
1  7
2  9
```

We can define a variable relative to other variables. And unlike in mathematics, we can even define or change a variable relative to itself. In fact, this is an important operation, as we will see, when it comes to while loops (see the chapter 2.9):

```
1  # We assign the value 7 to the variable a and display it.
2  a = 7
3  print('Value of a:')
4  print(a)
5
6  # Now we define b in relation to a
7  # Then we display a and b
8  b = a
9  print('Values of a and b after equalization:')
10 print(a)
11 print(b)
12
13 # Now we change b in relation to itself and increment it by 2
14 b = b + 2
15 print('Values of a and b after changing b:')
16 print(a)
17 print(b)
18
```

The output would be:

```
1  Value of a:
2  7
3  Values of a and b after equalization:
4  7
5  7
6  Values of a and b after changing b:
7  7
8  9
```

As you can see, even after equalizing the variables, we can still change them independently!

Concatenating Variables

Like the words / texts we combined in the print function (see 2.4) you can also combine text variables:

```
# We assign the value 'Hi' to the variable a and 'you' to the variable b.
a = 'Hi'
b = 'you'

# Now we define the variable c as the combination of a, a white space and b
c = a + ' ' + b

# Now we disply c
print(c)
```

The output would be:

```
Hi you
```

If you try to combine a variable, that contains a number with a variable that contains a word or text, you will get an error message. This is a common error. The reason is, that you are trying to combine different *data types*. The interpreter does not know whether to concatenate *strings* (=words or texts) or do an addition:

```
# We assign the value 'I am' to a, 9 to b and 'years old' to c
a = 'I am '
b =  9
c = ' years old'

# Now we define the variable c as the combination of a, b and c
print(a+b+c)
```

You will get the following error message:

```
---------------------------------------------------------------------------

TypeError                                 Traceback (most recent call last)

<ipython-input-19-c8b48e124d01> in <cell line: 7>()
5
6 # Now we define the variable c as the combination of a, b and c
----> 7 print(a+b+c)

TypeError: can only concatenate str (not "int") to str
```

We will discuss *data types* in the next chapter (2.6)

Further References

- `https://www.w3schools.com/python/python_variables.asp`
- `https://www.geeksforgeeks.org/python-variables/`

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2.6 Basic data types

Data types are the kind of information that is stored inside a variable. Depending on the type you can do certain operations (for example do additions). In Python *data types* are automatically assigned when you declare a variable.

Data types used in this course

Type	Abbreviation	Description	Example
string	str	A sequence of characters like a word or text	'The Mandalorian'
integer	int	Whole numbers (positive or negative)	42
floating point numbers	float	decimal numbers	3.2
boolean	bool	True or False	True
list	list	A list of values, see chapter 2.10	[9 , 2 , 7]
dictionary	dict	A dictionary of key-value pairs, see chapter 2.12	{"name": "Luke", "profession": "Jedi"}

Notes:

- For more datatypes see "Further References".
- Calculating with *floating point numbers* is imprecise with Python. This is due to rounding to certain digits. The math module is required to perform precise mathematical calculations.

How to read data types

With the *type function* we can read the data types of variables.

```
# We declare a variable a
a = 'hi'

# Now we use the type function to read the type
print(type(a))
```

The output would be:

```
<class 'str'>
```

Enforce data types

You can enforce a *data type* using the above mentioned abbreviations:

```
# We declare the variable a and read its type
a = 9
print(type(a))

# We enforce the datatype 'str' and read its type
a = str(a)
print(type(a))
```

The output would be:

```
<class 'int'>
<class 'str'>
```

Further References

- https://www.w3schools.com/python/python_datatypes.asp

- https://www.geeksforgeeks.org/python-data-types/

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2.7 The input function

The input function can be used to store user input inside a variable, making thus programs more flexible. The text in parentheses is displayed to the user.

```
1 age = input('How old are you?\n') #
2 print(age)
```

The characters "\n" mark a line break. This allows the user to start writing on a new line.

Further Reference

`https://www.geeksforgeeks.org/python-input-function/`

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2.8 If statements and indentation

If statements

- If a condition is true, one or more commands are executed.
- **Indentions** (= one tab or 4 spaces at the beginning of a line) make it clear which code belongs to the *if statement* and which does not (see below for an example)

I recommend using the **tab key** instead of 4 spaces. This is faster and easier. It also minimizes the risk of miscounting spaces. You can undo an indentation by pressing **shift + tab**.

Comparison operators

Comparison operators are used to compare values:

a == b	a equals b
a != b	a does not equal b
a < b	a is smaller than b
a <= b	a is smaller than or equal to b
a > b	a is bigger than b
a >= b	a is bigger than or equal to b

Simple If statements

```
a = 4 # We define the variable 'a' that we want to compare

if a == 4: # We check if the variable 'a' is equal to 4

    # The following indented text is only executed, if the condition is true.
    print(a)

print('The program continues...') # This code is independent of the if statement,
                                 # because there is no indentation.
```

Here the output would be:

```
4
The program continues...
```

Elif and else

```
a = 5 # we declare the variable 'a'
b = 5 # we declare the variable 'b'

if a < b: # We check if a is smaller than b

    print(str(a) + ' is smaller than ' + str(b))

elif a == b: # We check if a is equal to b

    print(str(a) + ' equals ' + str(b))

else: # If a is neither smaller than nor equal to b, the following code
      # is executed:
```

```
14
15      print(str(a) + ' is bigger than ' + str(b))
```

Nested if statements

You can use if-statements within if-statements.

```
1   a = 5 # We declare the variable 'a'
2
3   if a < 5: # We check if a is smaller than 5
4
5       print(str(a) + ' is smaller than ' + str(b))
6
7   else: # If a is not smaller than 5, the following code is executed:
8
9       if a == 5: # We check if a equals 5
10
11          print('a equals 6')
12
13      elif a == 6: # We check if a equals 6
14
15          print('a equals 5')
16
17      else: # a must be bigger than 6
18
19          print('a is bigger than 6')
```

Further References

- https://www.w3schools.com/python/gloss_python_if_statement.asp

- https://www.geeksforgeeks.org/python-if-else/

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2.9 While Loops

While loops are similar to *if statements* (see chapter 2.8). But instead of asking if a condition is true, they ask how long the condition is true. That is, as long as (or: while) a condition is true, certain commands are executed.

```
i = 1 # We create a counter, that we want to increment each time we loop
      # through the following function. When it reaches a certain value,
      # we want the while loop to stop.

while i < 6: # We check if the counter is smaller than 6

    print('The counter is ' + str(i) + '.') # display the counter
    i = i + 1 # increase the counter by 1, then we will loop again
    # through the function
```

Do not forget to increment the counter or you will create an infinite loop!

Just like in *if statements*, you can combine *while* with *else*:

```
i = 1 # our counter

while i < 6: # check if counter is smaller than 6

    print('The counter is ' + str(i) + '.') # display the counter
    i = i + 1 # increase the counter by 1

else:

    print('The counter is no longer less than 6')
```

There are some commands that give us more control over the iterations:

continue	skips the current iteration
break	terminates the entire loop

Break

```
i = 1 # our counter

while i < 6: # check if counter is smaller than 6

    if i == 3: # if the counter equals 3

        break # the entire loop is immediately terminated

    print('The counter is ' + str(i) + '.') # display the counter
    i = i + 1 # increase the counter by 1
```

Here the output would be:

```
1
2
```

Continue

```
i = 1 # our counter

while i < 6: # check if counter is smaller than 6

    if i == 3: # if the counter equals 3

        i = i + 1 # increase the counter by 1
        continue # the current iteration is skipped and the following code
        # is not executed

    print('The counter is ' + str(i) + '.') # display the counter
    i = i + 1 # increase the counter by 1
```

Here the output would be:

```
The counter is 1.
The counter is 2.
The counter is 4.
The counter is 5.
```

Note that we incremented the counter before the *continue statement*, otherwise we would have created an infinite loop.

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Further References

- https://www.w3schools.com/python/python_while_loops.asp
- https://www.geeksforgeeks.org/python-while-loop/

2.10 Lists

"List" is a *data type* (like *string* / *integer* / *float* ...). A python list is a list of numbers or strings and it can be stored inside a variable. See the following code example for further explanations.

```
# Example for a simple list
list1 = [ "Wookie", "Ewok", "Java", "Rodian" ]

# Lists can have duplicates or be empty:
list2 = [1, 3, 5, 7, 9, 7, 7, 7, 7, 7]
list3 = [ ]

# display the three lists
print(list1)
print(list2)
print(list3)

# with the len function you get the amount of elements inside a list
lengthList1 = len(list1)
print(lengthList1)

# There is a method for sorting lists. It will sort the list in an ascending
# order, either alphabetically (if the list contains strings) or numerically
# (if the list contains numbers).
list1.sort()
print(list1)
```

Lists are ordered and indexed. That means every entry of a list has an indexnumber, by which it can be accessed. The first entry has the index 0, the second one the index 1 and so on (In computer science we start by counting from 0 instead of 1). See the following code for examples and further explanations:

```
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]
# Indexnumber       0        1        2       3

print(starwarslist[0])  # the word #Wookie" will be displayed
print(starwarslist[1])  # the word "Ewok" will be displayed
print(starwarslist[2])  # the word "Java" will be displayed
print(starwarslist[3])  # the word "Rodian" will be displayed

# You can count backwards using negative indexes
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]
# Indexnumber      -4        -3      -2       -1

print(starwarslist[-1])  # the word "Rodian" will be displayed
print(starwarslist[-2])  # the word "Java" will be displayed
print(starwarslist[-3])  # the word "Ewok" will be displayed
print(starwarslist[-4])  # the word "Wookie" will be displayed

# You can also access a range of indexes (i.e., a portion of a list).
```

```
# The first number (before the colon) indicates the starting point
# The second number (after the colon) indicates the end point.
# Note that the end point is not included. See the following examples:

# Entry one and two will be displayed
print(starwarslist[1:3]) # Output: [ "Ewok" , "Java" ]

# Entry zero and entry one will be displayed
print(starwarslist[:2]) # Output: [ "Wookie", "Ewok" ]

# The entire list starting with entry 1 will be displayed
print(starwarslist[1:]) # Output: ["Ewok", "Java", "Rodian" ]

# The entire list without the last two entries will be displayed
print(starwarslist[:-2]) # Output: [ "Wookie", "Ewok" ]
```

What we said about the indexes of lists, also applies to strings, which are basically nothing else than a list of characters. Therefore you can access the characters of a string the same way you would access the entry of a list.

```
examplestring = 'Mandalorian' # we declare a variable with the datatype string

print(examplestring[0])          # displays the first character of the
                                 # variable 'examplestring'.
                                 # The output therefore is: 'M'

print(examplestring[:-1])        # displays every character of the variable
                                 # 'examplestring' except for the last
                                 # character. The output therefore is:
                                 # 'Mandaloria'
```

You an check if an item is in a list with the *in operator*:

```
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]

if "Wookie" in starwarslist:
    print("'Wookie' is in the list.")
```

That also applies to strings. That means you can check if a string is part of another string with the *in operator*:

```
longString = 'Mos Eisley, you will never find a more wretched hive of scum...'

if 'scum' in longString:
   print('Yes, the long string contains the word "scum".')
```

To check if an item is not in a list / a string is not in another string, type *not in* instead of *in*.

Adding / removing items

You can add items to a list with the *append method*. If you want to remove an item, you can either use the *pop method* (which uses the index number of the respective item) or the remove method (which uses the item itself).

```
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]

# Add items with the append method.
starwarslist.append("Duros")

# now the list is [ "Wookie", "Ewok", "Java", "Rodian", "Duros" ]

# there are two methods to remove entries:
starwarslist.pop(0) # removes the first entry
starwarslist.remove("Duros") # removes the entry "Duros"
```

Copying lists

Note: Copying lists does the same way as with other variables. When you equate lists, they refer to the same location in the computer's memory. Any change you make to one list will also be made to the other. In fact, they are identical. If you want to copy lists so that you can edit them independently later, you need the *copy method*.

```
# Copying other variables:
a = 6
b = a
b = b + 1
print(a) # The output is 6
print(b) # The output is 7

# Wrong way of copying lists
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]
newlist = starwarslist # equates the lists
newlist.remove("Ewok") # removes the item "Ewok"

print(starwarslist)
print(newlist)
# in both cases the output is:
# [ "Wookie", "Java", "Rodian" ]

# Right way of copying lists with the copy method
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]
newlist = starwarslist.copy()
newlist.remove("Ewok") # removes the item "Ewok"

print(starwarslist)    # output: [ "Wookie", "Ewok", "Java", "Rodian" ]
print(newlist)         # output: [ "Wookie", "Java", "Rodian" ]
```

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Further References

- https://www.w3schools.com/python/python_lists.asp
- https://www.geeksforgeeks.org/python-lists/

2.11 For loops

With for loops you can iterate over sequences (e.g. lists or strings). That means you can access every element of a list or a string one after the other. See the following code examples for further explanation.

```
# We define a list
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]

# We iterate over each item and display it.
for element in starwarslist:
    print(element)

# That means:
# We first look at the entry 'Wookie' and display it
# Then we look at the entry 'Ewok' and display it
# Then we do the same with 'Java' and 'Rodian'.
# In this example we used the variable "element".
# We could name the variable any way we like it
# (for example "item", "race")

# We can also loop through a string.
# Therefore we define the string "examplestring"
examplestring = "Mandalorian"

# Now we iterate over each item of the string and display it
for character in examplestring:
    print(character)
```

You can use the same commands as in while loops to get more control over iterations:

continue	skips the current iteration
break	terminates the entire loop

```
# We define a list
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]

# We iterate over the entries of the list
for entry in starwarslist:

    # We check, if the entry is equal to "Ewok"
    if entry == "Ewok":

        # We terminate the entire loop
        break

    print(entry)

# So the output will be [ "Wookie" ]
```

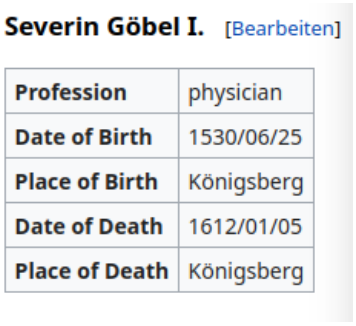
Space for your personal notes

Further References

- https://www.w3schools.com/python/python_for_loops.asp
- https://www.geeksforgeeks.org/loops-in-python/

2.12 Dictionaries

A dictionary is a bit like a list, but instead of index numbers you have keys. Like each index number in a list, each key in a dictionary has a value. This means that a dictionary consists of **key value pairs**. You can use dictionaries for example, to represent one entity in a database (e.g. a real person / thing):



Severin Göbel I. [Bearbeiten]

Profession	physician
Date of Birth	1530/06/25
Place of Birth	Königsberg
Date of Death	1612/01/05
Place of Death	Königsberg

Figure 2.2: An entity, as you would find it in a typical database. On the left side you can see the keys, on the right side the corresponding values.

Now let us see, how we can create a dictionary that corresponds to the entity 'Severin Göbel' from the image above.

```
# Dictionaries are enclosed in curly brackets. They are created according to
# the schema key : value. Note that we have to separate the key value pairs
# by commas

# We create the dictionary 'severinGoebelDict' for the person Severin Göbel
severinGoebelDict = {
    'profession': 'physician',
    'dateOfBirth': 1530,
    'placeOfBirth': 'Königsberg',
    'dateOfDeath': 1612,
    'placeOfDeath': 'Königsberg'
    }
# Now let us display the dictionary
print(severinGoebelDict)

# The output would be: {'profession': 'physician', 'dateOfBirth': 1530,
# 'placeOfBirth': 'Königsberg', 'dateOfDeath': 1612, 'placeOfDeath':
# 'Königsberg'}
```

You can access / add items by referring to the key (just like we used the index number of a list, when we wanted to know a certain value):

```
# We create the dictionary severinGoebelDict again
severinGoebelDict = {
    'profession': 'physician',
    'dateOfBirth': 1530,
```

```
    'placeOfBirth': 'Königsberg',
    'dateOfDeath': 1612,
    'placeOfDeath': 'Königsberg'
}

# Now let us display his profession:
print(severinGoebelDict['profession'])

# Using the same principle we can add a key-value pair to the dictionary.
# Let us say we want to add an entry about his wife
severinGoebelDict['wife'] = 'Ursula'

# Now lets us display the dictionary again
print(severinGoebelDict)

# The ourput will be: {'profession': 'physician', 'dateOfBirth': 1530,
# 'placeOfBirth': 'Königsberg', 'dateOfDeath': 1612, 'placeOfDeath':
# 'Königsberg', 'wife': 'Ursula'}
```

You can remove a key-value pair by pointing to the key with the *pop method*.

```
# We create the dictionary severinGoebelDict again
severinGoebelDict = {
    'profession': 'physician',
    'dateOfBirth': 1530,
    'placeOfBirth': 'Königsberg',
    'dateOfDeath': 1612,
    'placeOfDeath': 'Königsberg'
}

# Now let us remove the key value pair 'profession': 'physician',:
severinGoebelDict.pop('profession')
```

By pointing to the keys you can loop through a dictionary just like you can loop through a list:

```
# We create the dictionary severinGoebelDict again
severinGoebelDict = {
    'profession': 'physician',
    'dateOfBirth': 1530,
    'placeOfBirth': 'Königsberg',
    'dateOfDeath': 1612,
    'placeOfDeath': 'Königsberg'
}

# Now let us loop through the dictionary and display the keys
print('These are the keys:')
for x in severinGoebelDict:
    # we will display the key
    print(x)
```

```

# Now let us loop through the dictionary and display the values
print('These are the values:')
for x in severinGoebelDict:
    # we will display the values by using the keys
    print(severinGoebelDict[x])
```

The output would be:

```
These are the keys:
profession
dateOfBirth
placeOfBirth
dateOfDeath
placeOfDeath
These are the values:
physician
1530
Königsberg
1612
Königsberg
```

Sometimes dictionaries are stored inside another dictionary or inside a list. The latter is the case, for example, when you want to display not one, but several entities of the same type within a database (for example, all persons). We will look at an example in the course. Otherwise, have a look at 'Further references'.

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Further References

- https://www.geeksforgeeks.org/python-dictionary/
- https://www.geeksforgeeks.org/loops-in-python/

2.13 Functions

A function is a block of code that is executed only when *called*, which means you can define one or more commands as a function that can be executed on demand. For this we use the keyword *def*:

```
# We define the function 'printfunction' that displays the word 'Hello'
def printfunction():
    print('Hello')

# Now we call the function. That means we execute it.
# If we would not call the function, nothing would happen.
printfunction()
```

You should always give functions descriptive names that accurately describe their purpose (e.g., "listComparison" instead of "myfunction"). This makes the code easier to read and helps other people understand what the program is doing. I myself add a comment to all functions I write, explaining the purpose and operation of the function. That way, even a year later, I know why I wrote a function the way I did.

Arguments / parameters

When you call a function, you can pass *arguments / parameters* to the function. This means that each time you call a function, you can pass a different input to the function:

```
# We define the function 'addWhiteSpaces'. It adds a white space after
# each character of a word, that is passed to the function as an argument.
def addWhiteSpaces(word):

    # We create a variable 'newWord' containing an empty string,
    # where we will store our result
    newWord = ''

    # now we iterate over each character of the word:
    for character in word:

        # Now we add the character to the variable newWord and
        # add a white space
        newWord = newWord + character + ' '

    # Now the loop is finished, but we have on white space too much at the end
```

```
    # of 'newWord'. So we will display newWord without the last letter
    print(newWord[:-1])

# Now we can call the functions and pass different words to it as arguments
addWhiteSpaces('Hello')
addWhiteSpaces('You')
addWhiteSpaces('Hi')
```

The output would be:

```
H e l l o
Y o u
H i
```

The number of arguments passed to a function must match the number of arguments defined in the function:

```
# We define a function 'combineWords'. It has two arguments: 'word1' and 'word2'
# The goal is to combine two words with a blank space between them.
def combineWords(word1, word2):
    print(word1 + ' ' + word2)

# Now we call the function and pass the words 'Hello' and 'You' as arguments
combineWords('Hello', 'You')
```

Return values

Sometimes you just want a function to return a value so that you can move on. This can be the case, for example, if you want to generate an intermediate result to use in further code or in another function. This is done with the *return keyword*:

```
# We create the function "combineWords". It has two arguments: word1 and word2
def combineWords(word1, word2):
    # it returns a string, that is the concatenation
    # of word1, a white space and word2
    return word1 + ' ' + word2

# We call the function combineWords and pass the words "Hello" and "you".
# The result is stored in the variable a
a = combineWords('Hello', 'you')
# We print the variable a
print(a)
# The output will be: Hello you
```

Local and global variables

A variable created outside a function is a *global variable*. A variable created inside a function is a *local variable*. *Global variables* can be accessed from anywhere, *local variables* can only be accessed within their respective functions.

This is why the following code will not work:

```
# we define the helloFunction. It will display 'Hello'
def helloFunction():
    x = 'Hello' # We define x
    print(x)    # We display x

helloFunction() # We call the function helloFunction
print(x) # We try to display x, but x is not a global variable.
         # An error will occur
```

If you want to define a *global variable* inside a function, you can use the *global keyword*:

```
# we define the function globalVariableInsideAFunction. It will display 'Hi'
def globalVariableInsideAFunction():
    global x # We define x as global
    x = 'Hi' # We define x

# We call the function
globalVariableInsideAFunction()

# We display x
print(x)
```

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Further References

- https://www.w3schools.com/python/python_functions.asp
- https://www.w3schools.com/python/python_variables_global.asp
- https://www.geeksforgeeks.org/python-functions/
- https://www.geeksforgeeks.org/global-local-variables-python/

2.14 Interacting with files

Working with files can be very useful. I recommend using *with open*. It is similar to a function with a few arguments:

- First of all the filename in quotes (e.g. 'starwars.txt')

- Then we define the type of access we want to have. This is a single letter that tells the interpreter, what we want to do. This means we declare, if we want to read a file ('r'), write a file ('w') or append something to the end of the file ('a'). If it does not already exist, we need to add + to the letter (e.g. 'w+')

- Sometimes you need to specify the encoding (for example: encoding='utf-8'). This will be explained in more detail during the course.

Lets us look at an example. First of all let's open an already existing file for writing:

```
1 # We want writing access to the existing file 'starwars.txt'
2 # It is encoded with 'utf-8'
3 # We store the accessed file in the variable 'outputfile'
4 with open('starwars.txt', 'w', encoding='utf-8') as outputfile:
5     # Now we write 'A long time ago...' into the file
6     outputfile.write('A long time ago...')
```

Now we want to open an existing file and read its content. There are two ways to do this: the *read method* and the *readlines method*. With the read method we can store the entire content of the file in a single string variable, with the readlines method we can store all the lines of the file in a single list variable (a list, where each entry corresponds to a line of the file).

Now let us use the read method:

```
1 # We want reading access to the existing file 'starwars.txt'
2 # It is encoded with 'utf-8'
3 # We store the accessed file in the variable 'inputfile'
4 with open('starwars.txt', 'r', encoding='utf-8') as inputfile:
5     # Now we store the filecontent as a string in the variable content
6     content = inputfile.read()
7     print(content)
```

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Further References

- https://www.w3schools.com/python/python_file_handling.asp
- https://www.geeksforgeeks.org/file-handling-python/
- https://automatetheboringstuff.com/2e/chapter9/

2.15 String functions

Strings are similar to lists. To access certain parts of a string or to check if a string is inside another string, see chapter 2.10.
But there are also a number of methods specific to strings. Here are some important ones:

endswith()	Checks if a string ends with a specific value (e.g. a character).
find()	Finds a string inside another string and returns the indexnumber, where the string was found.
isdigit()	Checks if the characters of a string are digits.
islower()	Checks if the characters of a string are lowercase.
isupper()	Checks if the characters of a string are uppercase.
rfind()	see the *find method*, but rfind returns the indexnumber, where the string was found.
split()	Splits a string at a separator (like a comma or semicolon for example). The result is stored as a list.
splitlines()	Splits a string into lines. The result is stored as a list.
startswith()	Checks if a string starts with a specific value (e.g. a character).
strip()	Removes white spaces at the beginning and end of a string. Instead of white spaces other characters can be removed as well.

For further methods see Further References.

Further References

- `https://www.w3schools.com/python/python_strings_methods.asp`

- `https://automatetheboringstuff.com/2e/chapter6/`

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2.16 Error handling

Sometimes you do not want your entire program to quit, when a small error occurs. We can solve this problem with the statements *try* and *except*.

```
# We create a list with three words
wordlist = [ 'Maria', 'John', 'Joseph' ]

# We want to display the 5th character of each word, but the word 'John'
# has only 4 characters and would throw an error that would
# stop the entire program. So use 'try' and 'except'

# we iterate over the list
for word in wordlist:

    try: # we check, if we can display the 5th character
        print(word[4]) # remember: in computer science we start counting with 0

    except: # if this is not possible, we want to display a message
        print('This word has less than five characters.')
```

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Further References

- https://www.w3schools.com/python/python_try_except.asp
- https://www.geeksforgeeks.org/python-exception-handling/

2.17 Importing modules

A module is a set of ready-to-use functions that you can import and start using right away. This is done via the *import* statement.

Let us import the *time* module. With it we can make the program wait for a certain number of seconds.

```
1 # We import the time module
2 import time
3
4 # We make the program wait for 10 seconds
5 time.sleep(10)
6
7 # Now we display 'Ten seconds have passed.'
8 print('Ten seconds have passed.')
```

In general, most modules should already be installed in Google Colabs. If a module is not installed, you can install it with the following command, where MODULENAME is the name of the package you want to install:

```
!pip install MODULENAME
```

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Further References

- https://www.w3schools.com/python/python_modules.asp
- https://www.geeksforgeeks.org/python-modules/

Chapter 3

Useful modules for the Digital Humanities

There are many useful modules for almost every case you can imagine. The following list will show you some of the most useful ones for DH projects. Do not hesitate to try them out. After all, the goal of this workshop is to open up perspectives so that you can choose exactly what you need for your specific project.

3.1 RegEx

With **regular expressions** you can search for strings, that matter a specific pattern, like for example phonenumbers, dates, certain types of names... They can be very helpful and are essential, if you work with texts.

Tutorials:

- `https://automatetheboringstuff.com/2e/chapter7/`
- `https://www.w3schools.com/python/python_regex.asp`
- `https://www.geeksforgeeks.org/regular-expression-python-examples/`

3.2 Interacting with CSV and JSON Files

CSV and JSON files are common formats when it comes to store or exchange information. For each file type there is a certain module:

Tutorials:

- `https://automatetheboringstuff.com/2e/chapter16/`
- `https://www.w3schools.com/python/python_json.asp`
- `https://www.geeksforgeeks.org/python-json/`
- `https://www.geeksforgeeks.org/working-csv-files-python/`

3.3 Machine Learning

TensorFlow is a good tool for machine learning.

Websites and Tutorials:

- `https://www.geeksforgeeks.org/introduction-to-tensorflow/`
- `https://pypi.org/project/tensorflow/`
- `https://www.tensorflow.org/learn/`

3.4 Working with Websites and XML-Files

With the **request module** you can access websites, check if they are active and download their source code.

- **Short tutorial:** `https://www.w3schools.com/python/module_requests.asp`
- **Longer tutorial:** `https://www.geeksforgeeks.org/python-requests-tutorial/`

When you are working with HTML or XML files, **Beautiful Soup** is the module you want to have. It is very powerful and useful.

Tutorials and Documentation:

- `https://beautiful-soup-4.readthedocs.io/en/latest/`
- `https://www.geeksforgeeks.org/implementing-web-scraping-python-beautiful-soup/`

3.5 Natural language processing (NLP)

NLTK (Natural Language Toolkit): It is a tool for analyzing and working with language using computational linguistics. Its data is based on "50 corpora and lexical resources".

- **Website and introduction:** `https://www.nltk.org/`

CLTK (Classical Language Toolkit): It is the equivalent of the NLTK, but for the languages of pre-modern Eurasia.

- **Website and introduction:** `http://cltk.org/`

3.6 Database management

mysql.connector is a module that allows you to access MySQl databases.

- **Tutorial:** `https://realpython.com/python-mysql/`

Pywikibot is a module that allows you to access *MediaWiki databases* through a bot. It can be a handy tool, but the installation is tricky.

- **Website and Tutorial:** `https://www.mediawiki.org/wiki/Manual:Pywikibot`

3.7 Data analysis and visualization

Numpy is the module to use when it comes to *data analysis*. It is incredibly fast and offers various functions to perform all kinds of calculations.

- **Website:** `https://numpy.org/`
- **Tutorial:** `https://www.geeksforgeeks.org/python-numpy/`

Pandas is built on top of numpy, making the import and analyzation of data easier. You can combine it with **matplotlib** to visualize your data.

- **Data visualization tutorial:**
  `https://www.geeksforgeeks.org/data-visualization-with-python/`
- **Matplotlib tutorial:**
  `https://www.geeksforgeeks.org/matplotlib-tutorial/`
- **Pandas tutorial:**
  `https://www.geeksforgeeks.org/pandas-tutorial/`

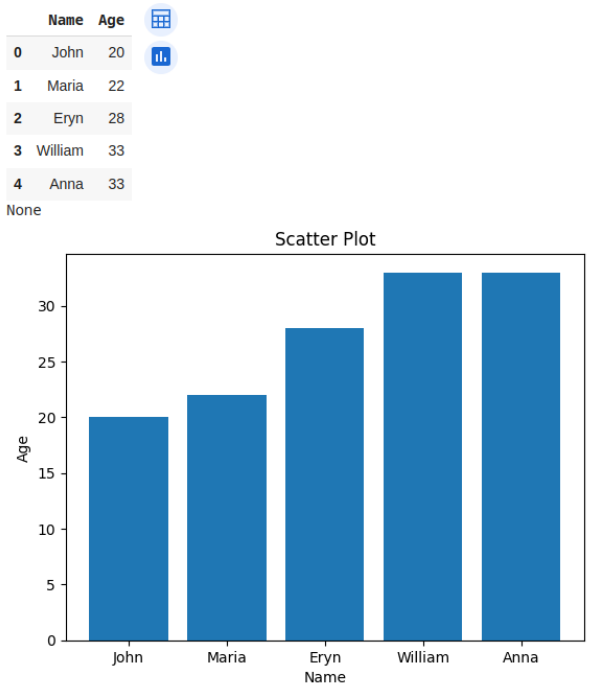

Figure 3.1: An automatically generated bar chart from a csv file (Matplotlib and pandas were used)

3.8 Network Visualization

Pathpy is a mighty and flexibel tool for network analysis and visualization.

- **Website and tutorial** `https://www.pathpy.net/`

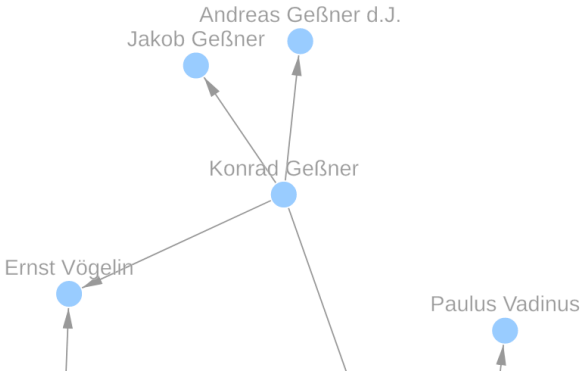

Figure 3.2: Visualization of a network section with Pathpy

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Chapter 4

Outlook

4.1 Possible Next Steps

Local installation

You may want to install python locally on your computer. There are many good editors you can use, among them *Visual Studio Code* and *PyCharm*.

Visual Studio Code allows you to work with almost any programming language. Pycharm is specifically designed for Python and has a free community version as well as a paid professional version. Both are great editors.

You can also use other editors. But for security reasons, make sure they work with *virtual environments* so that installing modules does not affect your system.

Advanced Studies

Chapter 3 introduced us to many new modules that do not require professional knowledge of Python. Do not hesitate to try them out.

However, this course did not cover some topics that are important if you want to work with Python at a professional level. These include the following not-so-simple topics:

- *Recursion*
- *Object Orientation*

If you want to get more than a basic understanding of Python, you should take a closer look at these topics. For this, I recommend the websites and tutorials mentioned in chapter 1.2.

I also recommend reading the following article on *clean code*:
`https://www.geeksforgeeks.org/best-practices-to-write-clean-python-code/`

4.2 Goodbye

No matter how deep you want to go with Python, hopefully this workshop has been fun, given you new insights, and shown you numerous perspectives on how to use Python. Most of all, it should have awakened your curiosity and made you want to start programming right away. I wish you a lot of fun!

Figure 4.1: `https://clipground.com/images/erfolg-clipart-4.jpg` (CC BY 4.0 Deed)

List of Figures

Cheat Sheet

Data types used in this course

Type	Abbreviation	Description	Example
string	str	A sequence of characters like a word or text	'The Mandalorian'
integer	int	Whole numbers (positive or negative)	42
floating point numbers	float	decimal numbers	3.2
boolean	bool	True or False	True
list	list	A list of values	[9 , 2 , 7]
dictionary	dict	A dictionary of key-value pairs	{"name": "Luke", "profession": "Jedi"}

print and input functions

```
print('Hello')

a = input('Please write something\n')
print('you wrote ' + a)
```

if statements

```
if a < 6:
    print('a is smaller than 6')
elif a == 6:
    print('a is equal to 6')
else:
    print('a is bigger than 6')
```

while loops

```
i = 0
while i < 5:
    print(i)
    i = i + 1
```

lists

```
examplelist = [ 1, 2, 3 ]

for i in examplelist:
    print(i)
```

for loops

```
starwarslist = [ "Wookie", "Ewok", "Java", "Rodian" ]

for entry in starwarslist:
    print(entry)
```

functions

```
def myfunction(word):
    returntext = 'your word is ' + word
    return returntext

print(myfunction('Hello'))
```

dictionaries

```
exampleDict = {'name': 'Paul', 'age': 39}

for i in exampleDict:
    print(exampleDict[i])
```

interacting with files

```
with open('hello.txt', 'r', encoding='utf-8') as inputfile:
    text = inputfile.read()
    print(text)
```

error handling

```
try:
    print(a)
except:
    print('Error')
```

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