efl Data Science Course

Introduction

Lecturers

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Research Assistant

Nicolas Pfeuffer studied Business Informatics at the Goethe-Universität Frankfurt (M.Sc.). During his master's program,...

M.A. Timo Schäfer

Research Assistant

Timo Schäfer received his Master in Banking&Finance and Data Science from the University of Zurich in February 2018 and...

M.Sc. Benjamin M. Abdel-Karim

Research Assistant

Since March 2018, Benjamin M. Abdel-Karim is a research assistant of Prof. Dr. Oliver Hinz at the Chair of Information...

M.Sc. Jens Lausen

Research Assistant

Jens Lausen received a Bachelor's degree in Management and Economics and a Master's degree in Management from Johannes...

The efl

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Industry-academic partnership

Universities

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FACTSET

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efl | the Data Science Institute

Original Mission:

- Investigate and co-shape Digital Finance 2.0
  - Web-based selfservices of customers
- Research was performed in three different Layers:
  - Customers in E-Finance
  - E-Financial Markets and Market Infrastructures
  - IT Infrastructures: Service Systems in E-Finance

New Mission (Since 2019):

- Use expertise in Data Science to deliver cutting edge research in the fields of
  - Financial Services
  - Retail & Marketing
  - Health
  - Law

Teaching

Day 1 (Python Course) (07.10.2019)

9:00 - 10:30 Uhr
Python Basics
Introduction and Primitive Data Types

10:40 - 12:10 Uhr
Data Structures
Lists, Sets, Dictionaries

13:30 - 15:00 Uhr
Control Structures
Loops (for, while), case distinction (if, else)

15:15 - 16:45 Uhr
Functions
Structure of Functions and Application

Day 2 (Python Course) (08.10.2019)

9:00 - 10:30 Uhr
Helpful functions for data processing
Libraries: os, re, csv

10:40 - 12:10 Uhr
Data types and data structures
Libraries: numpy, pandas

13:30 - 15:00 Uhr
Data import and visualization
Libraries: csv (cont'd), matplotlib

15:15 - 16:45 Uhr
Outlook: Data Science
Exemplary implementation of a KDD process

Day 3 (Data Science) (11.10.2019)

9:00 - 10:30 Uhr
Introduction to Data Science
Terminology and basic concepts

10:40 - 12:10 Uhr
Working with Data
Preprocessing, explorative data analysis

13:30 - 15:00 Uhr
Data Analysis I
Classification

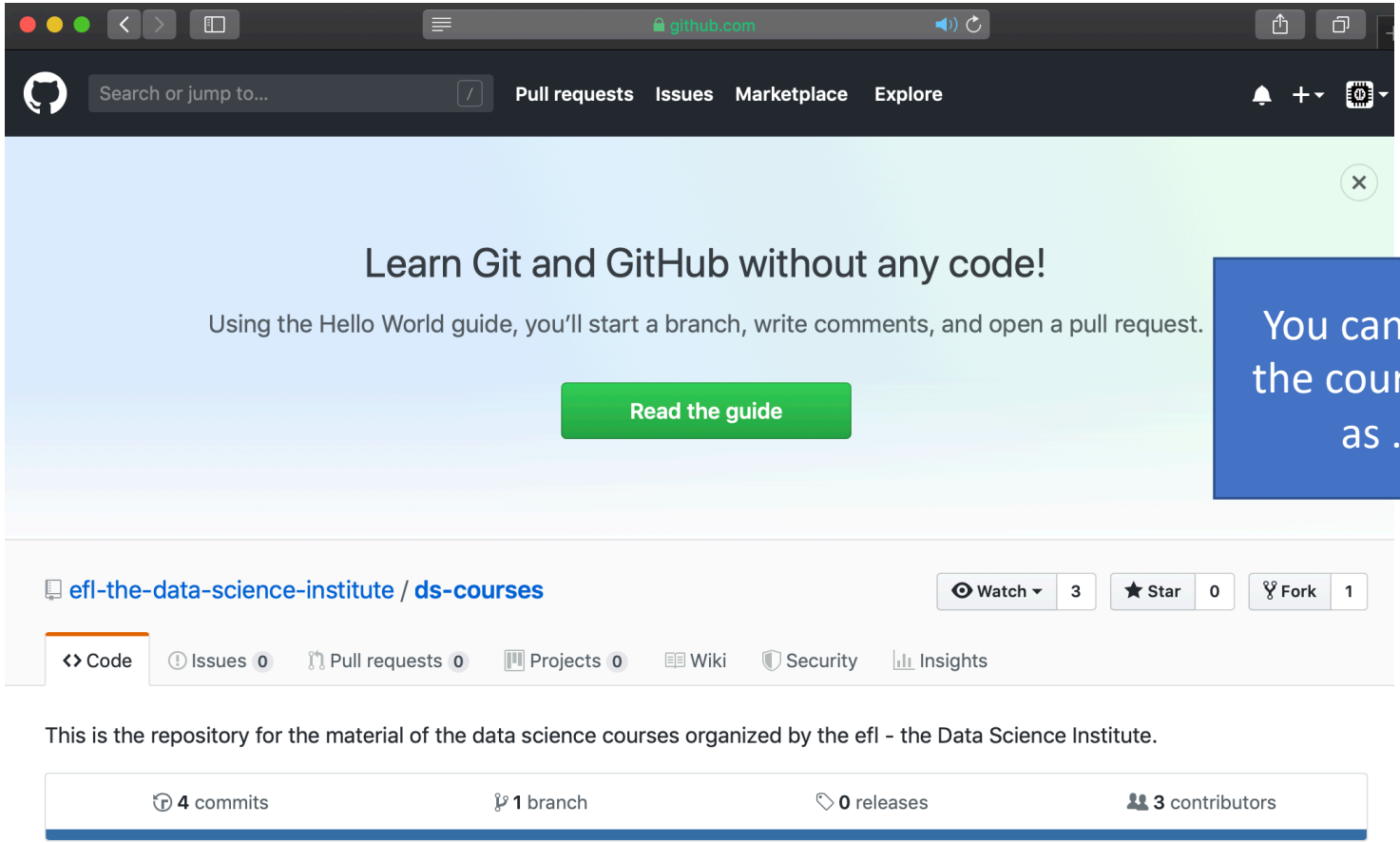
15:15 - 16:45 Uhr
Data Analysis II
Neural Networks

Teaching

Day 1 (Python Course) (07.10.2019)	Day 2 (Python Course) (08.10.2019)	Day 3 (Data Science) (11.10.2019)
9:00 - 10:30 Uhr Python Basics Introduction and Primitive Data Types	**9:00 - 10:30 Uhr** Helpful functions for data processing Libraries: os, re, csv	**9:00 - 10:30 Uhr** Introduction to Data Science Terminology and basic concepts
10:40 - 12:10 Uhr Data Structures Lists, Sets, Dictionaries	**10:40 - 12:10 Uhr** Data types and data structures Libraries: numpy, pandas	**10:40 - 12:10 Uhr** Working with Data Preprocessing, explorative data analysis
13:30 - 15:00 Uhr Control Structures Loops (for, while), case distinction (if, else)	**13:30 - 15:00 Uhr** Data import and visualization Libraries: csv (cont'd), matplotlib	**13:30 - 15:00 Uhr** Data Analysis I Classification
15:15 - 16:45 Uhr Functions Structure of Functions and Application	**15:15 - 16:45 Uhr** Outlook: Data Science Exemplary implementation of a KDD process	**15:15 - 16:45 Uhr** Data Analysis II Neural Networks

- Completion of tasks from the last hour
- Submission: Description of how the tasks were solved
- Formalities:
  - Min. 2 pages (Arial 11, 1.5 Line spacing , 3 CM Correction margin)
  - Code must be delivered separately (code folder)

Course Material?



You can download the course material as .zip file

https://github.com/efl-the-data-science-institute/ds-courses

Why you are here

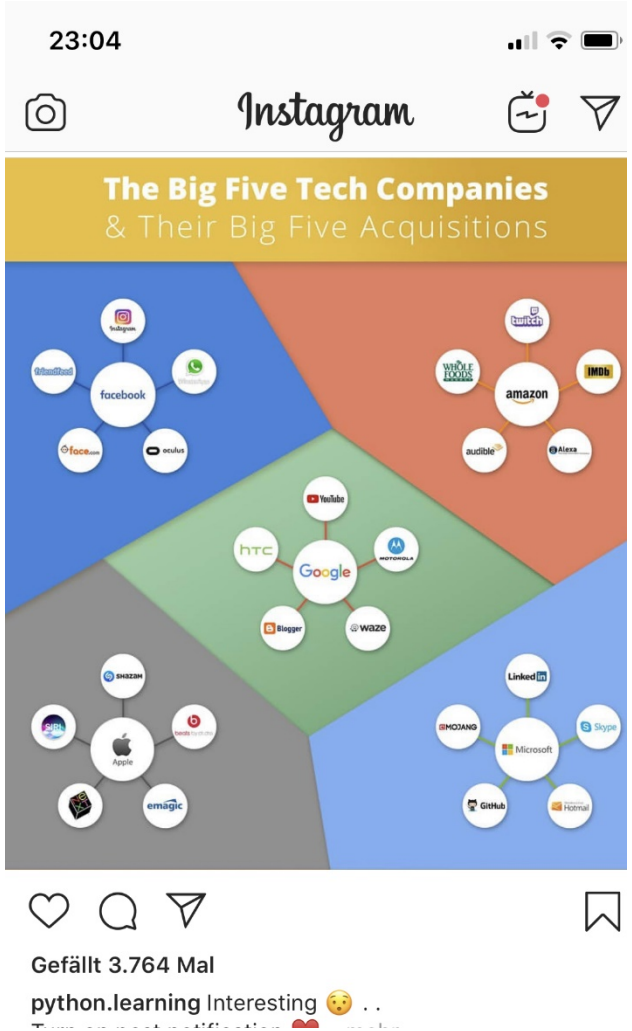
Kenntnis in Python und anderen Softwareprogrammen werden auf dem heutigen **Arbeits- und Praktikumsmarkt oft vorausgesetzt**. Um auch über die in den Vorlesung vermittelten Inhalte hinaus etwas
über statistische Softwareprogramme zulernen, möchte ich an dem Kurs teilnehmen.

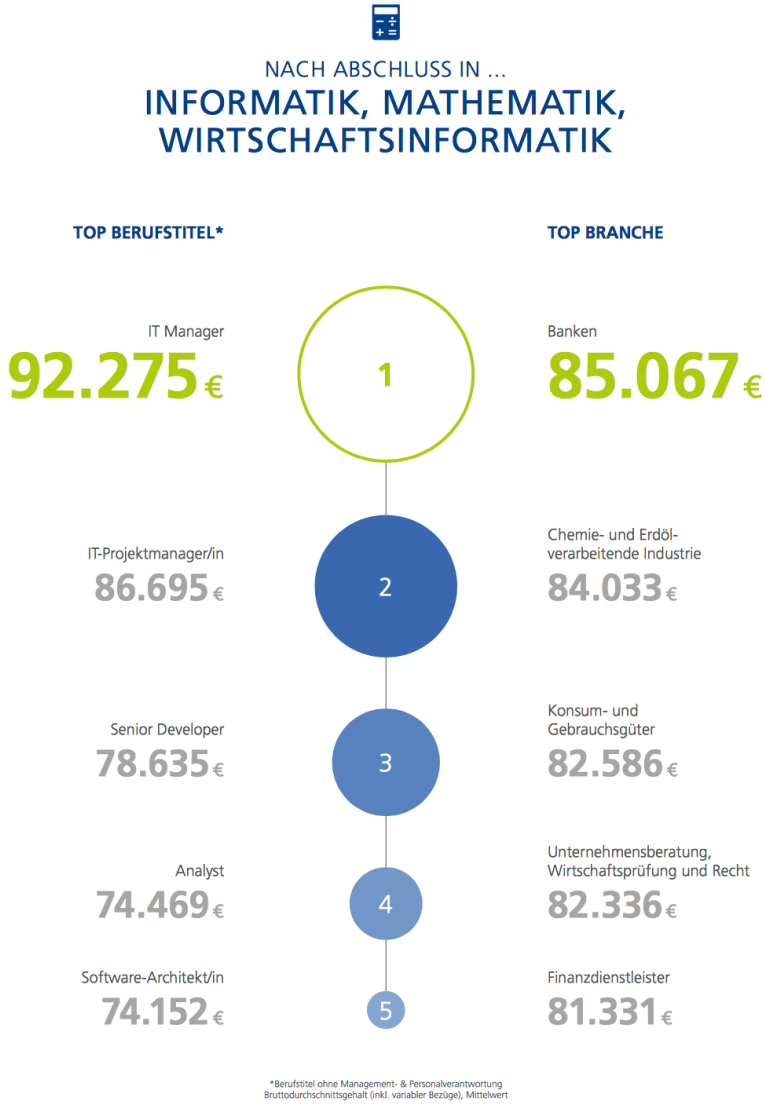
Ich möchte mich in diesem Bereich fortbilden, um bei einer Bachelor-Arbeit Daten auszuwerten und zu visualisieren. Darüberhinaus möchte ich wahrscheinlich **einen quantitativ-orientierten Master belegen und halte es daher für sinnvoll einen ersten Python-Kurs zu belegen.**

Auffrischen von Python, neue Einblicke in Software

Bei meiner aktuellen Werksstudentenstelle **merke ich immer wieder, wie Entscheidungen sehr oft datengetrieben werden** und welche Rolle gut aufgearbeitete Daten spielen.
Daher würde ich gerne, um mich beruflich und persönlich weiterzubilden, gerne an dem Kurs teilnehmen.

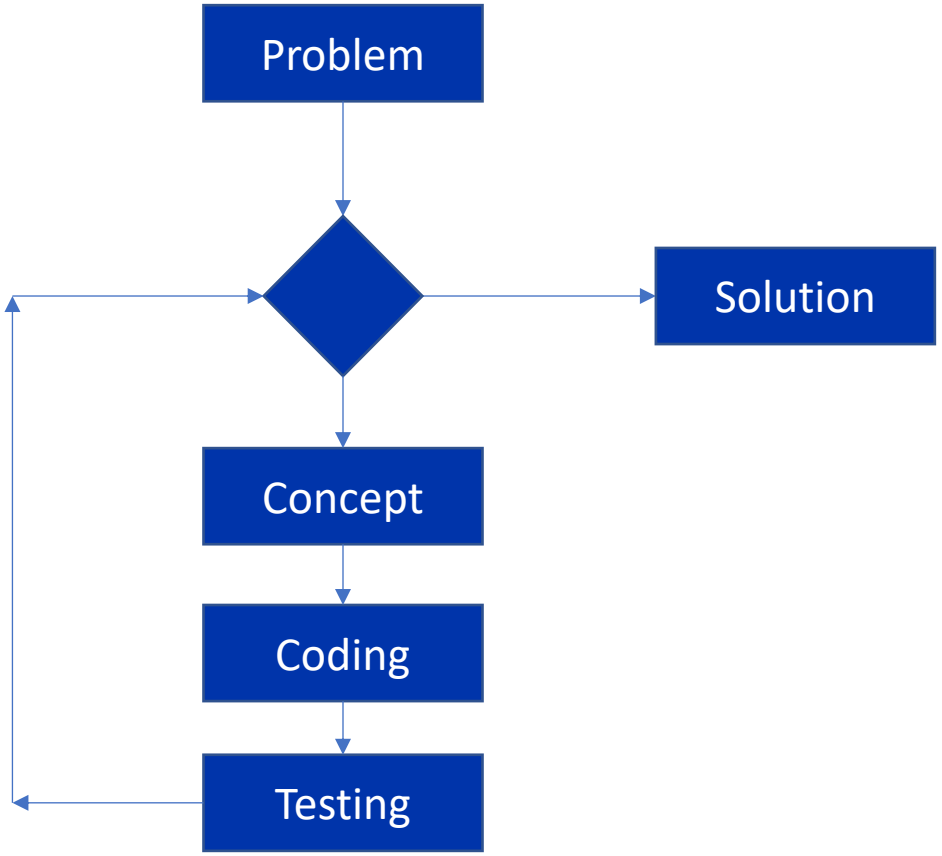
Why Coding?





Stepstones - Gehaltsreport

What is coding?



Why Python?

- Released in 1991 by Guido van Rossum
- With the explosive growth of ‘big data’ in disciplines such as bioinformatics, neuroscience and astronomy, programming know-how is becoming ever more crucial (Perkel 2015, p. 125).

YouTube [2]

[3]

[6]

Developed in Python and CUDA

Dropbox

[4]

Neurokernel [8]

Spotify®

[7]

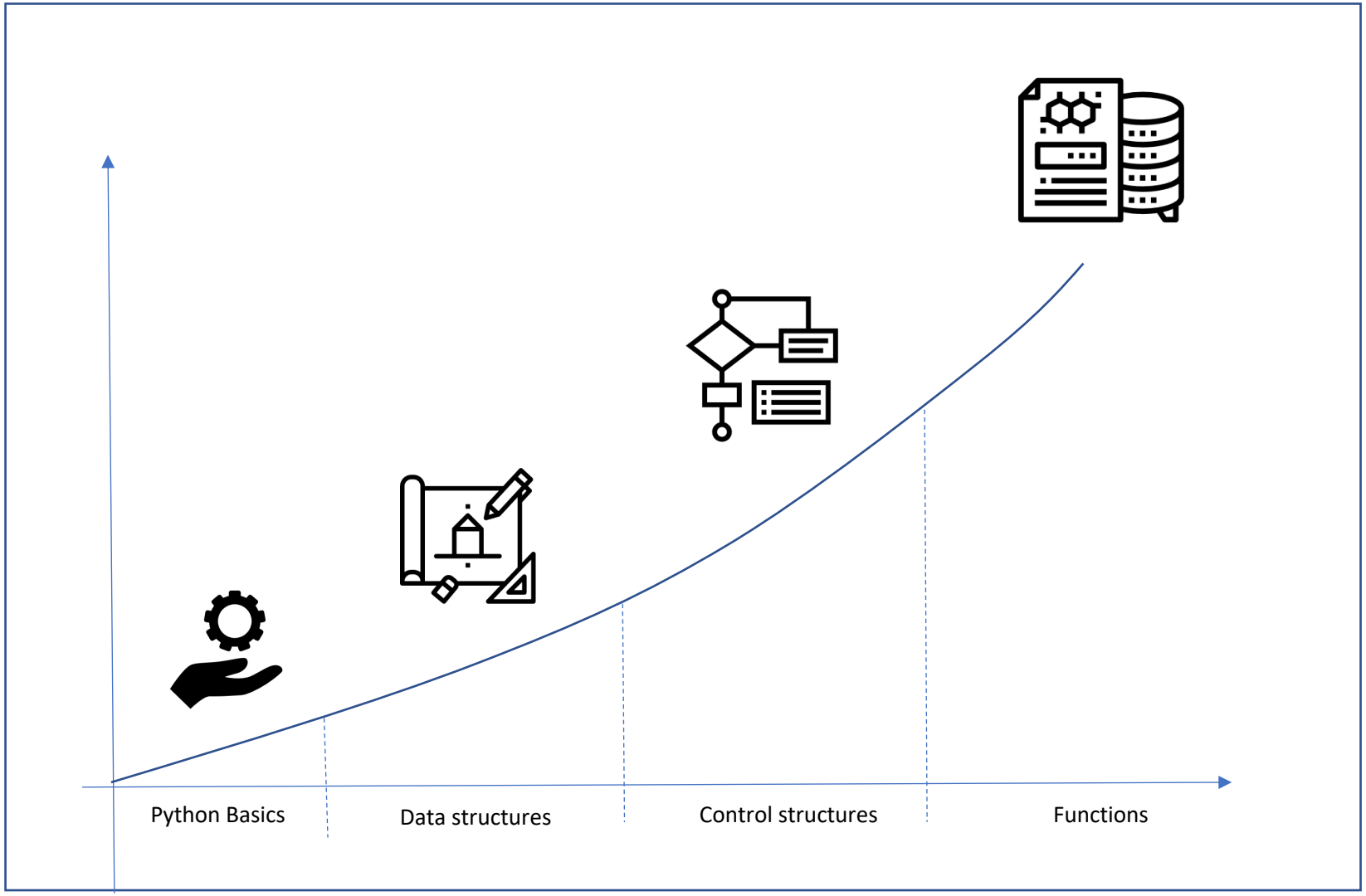
The elementary basics in Python

- Philosophy and difference to conventional programming languages
  - Higher programming language
  - It´s simple
  - Fast to read
  - Structuring by indenting
  - No {} or ; => Faster to Code
  - Data types are managed dynamically. There is no static type check like in java
  - Widespread in science
  - Extensive Support Libraries (important data science, math and many more)
  - Integration Feature
  - Productivity (Many Frameworks such as unit testing)

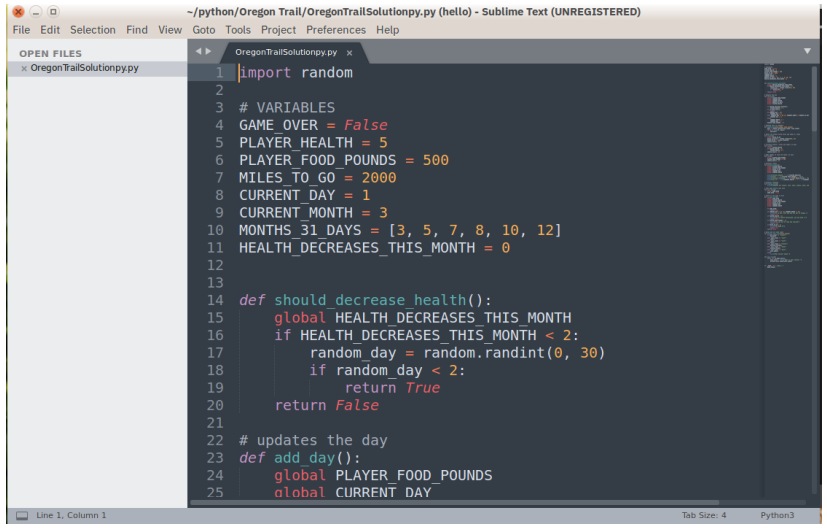
Introduction goals

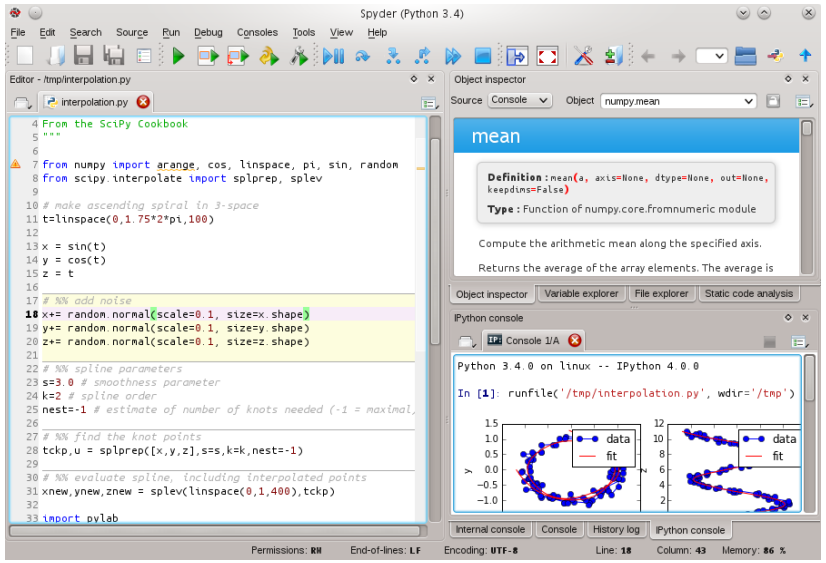
- Introduction to programming
- For beginners
- The module is interactive! Use your computer
- **We develop the solutions together!**
- Please be on time
- There are no dumb questions
- Nobody knows everything
- Copying solutions is plagiarism

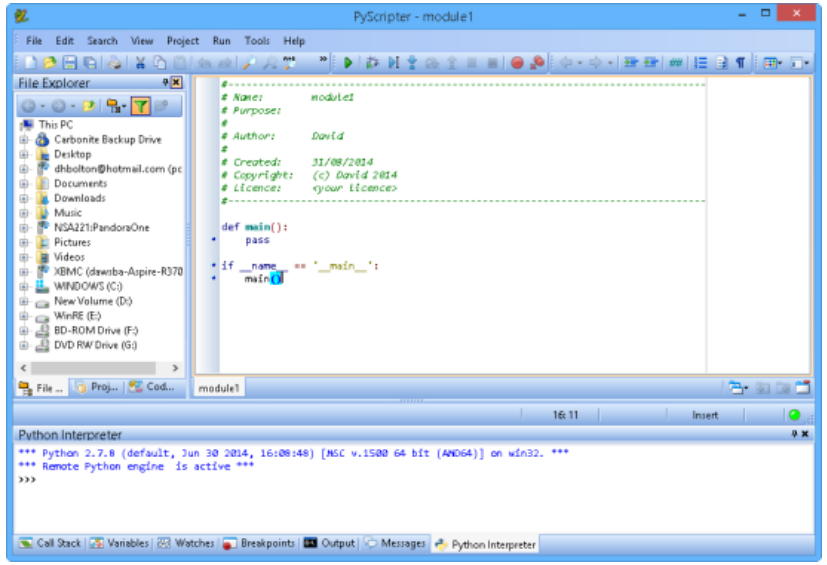
Learning Curve for Today



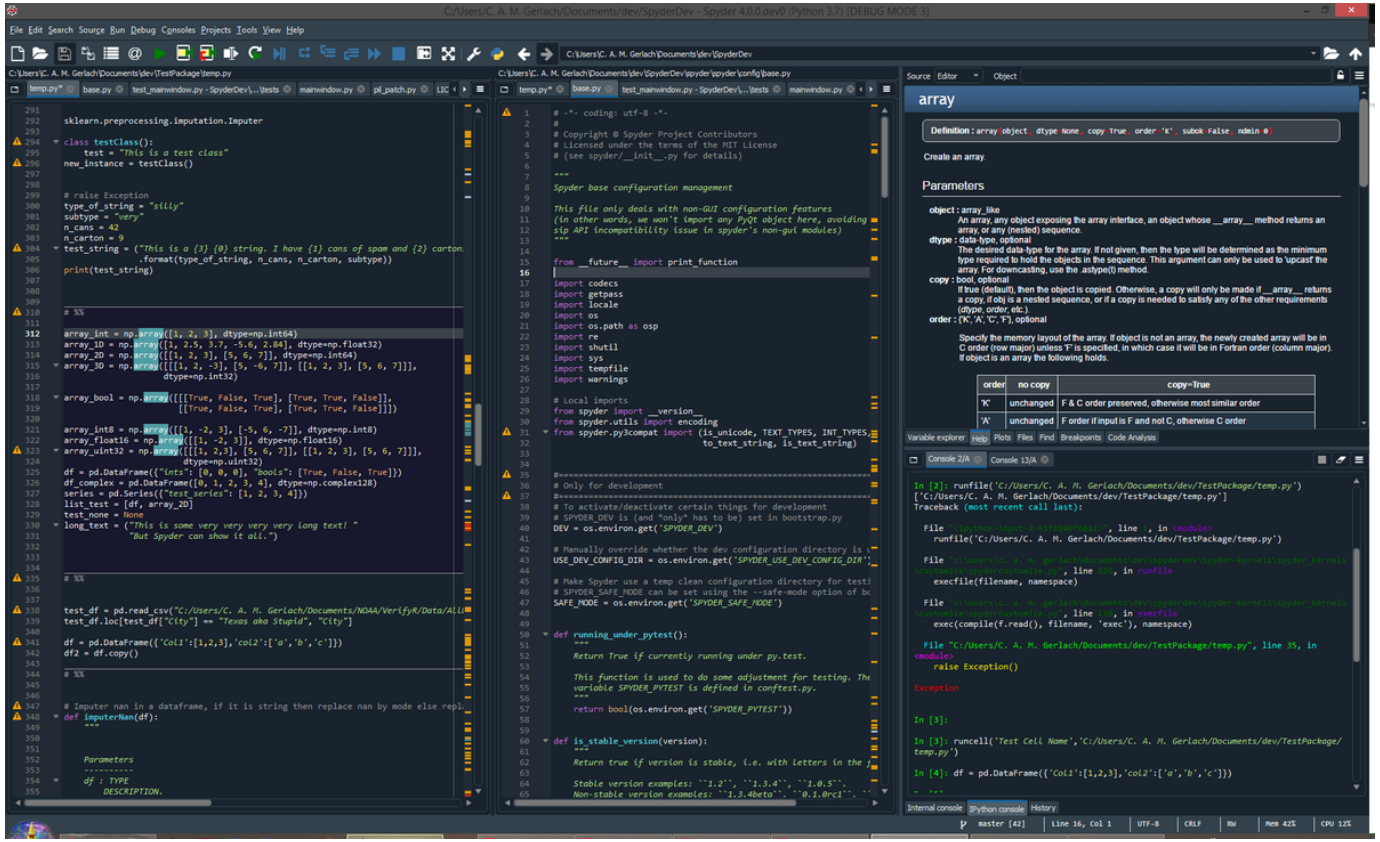
IDE a deeper look? The Problem of Choice







What We Use for This Course



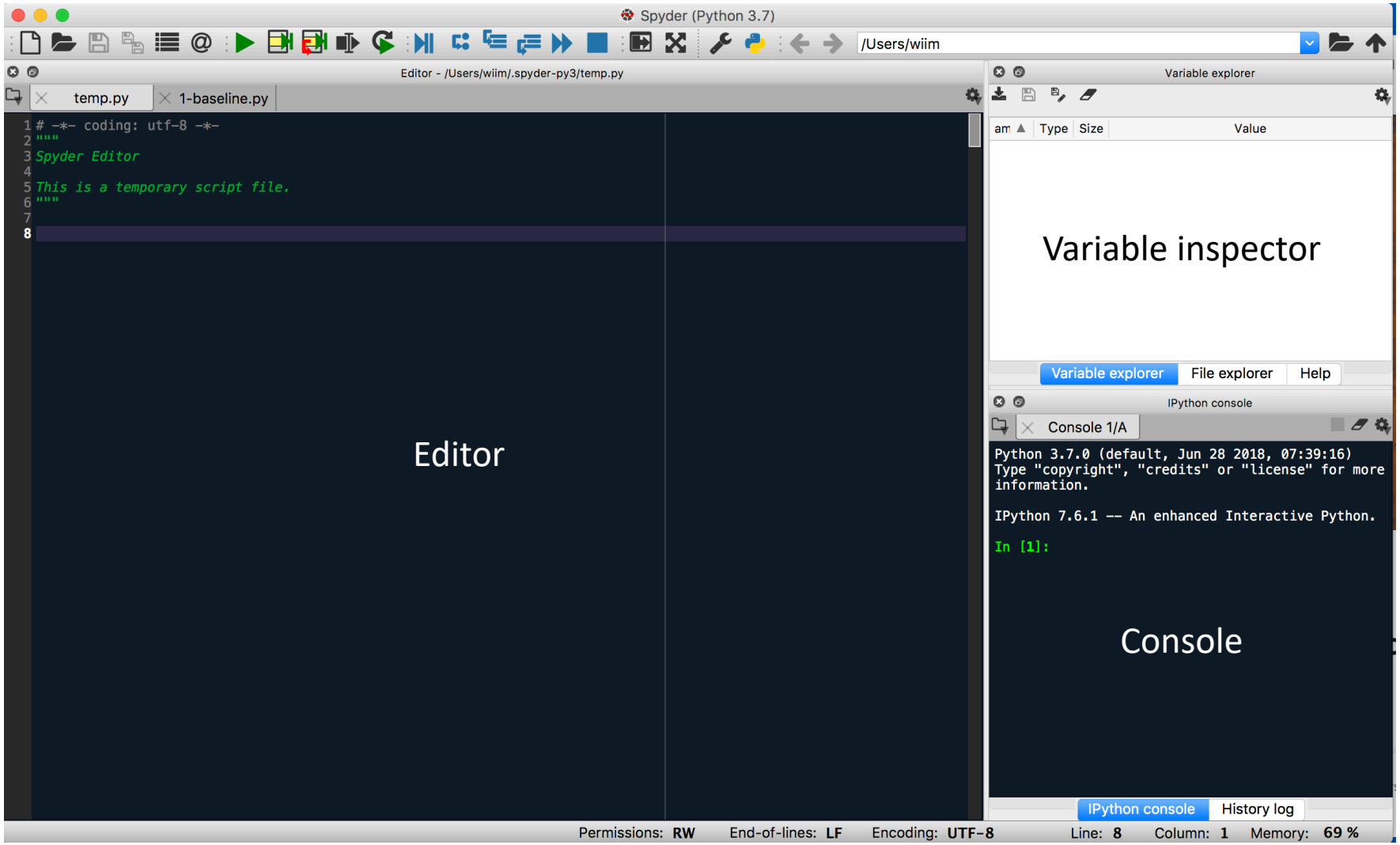
Practice and Questions

Take your computer and let's get started!

Create a Folder ‘Day 1’ on our Desktop

Launch Spyder and select the folder

Our Tool


Spyder (Python 3.7)
/Users/wiim
Editor - /Users/wiim/.spyder-py3/temp.py
temp.py
1-baseline.py
-*- coding: utf-8 -*-
"""
Spyder Editor
This is a temporary script file.
"""
Editor
Variable explorer
Type
Size
Value
Variable inspector
Variable explorer
File explorer
Help
IPython console
Console 1/A
Python 3.7.0 (default, Jun 28 2018, 07:39:16)
Type "copyright", "credits" or "license" for more information.
IPython 7.6.1 -- An enhanced Interactive Python.
In [1]:
Console
IPython console
History log
Permissions: RW
End-of-lines: LF
Encoding: UTF-8
Line: 8
Column: 1
Memory: 69 %

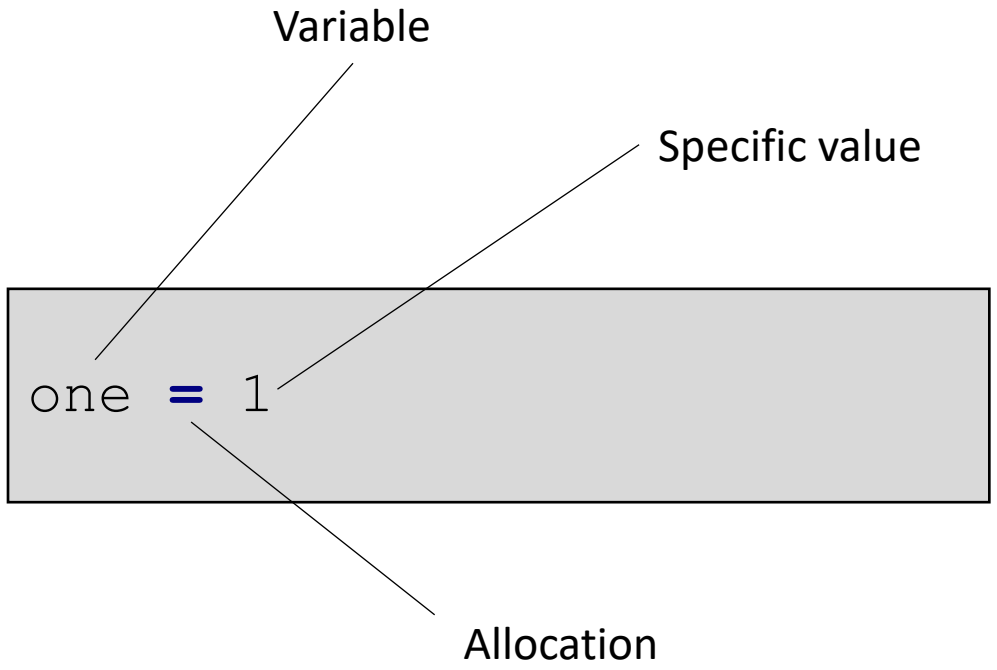
Hello World

- Hello World
- Let‘s try our first example!
- Display “Hello World” on the console

Hello World

```
print('Hello World')
```

Abstraction (Computer Science)
The first step - The concept of variable

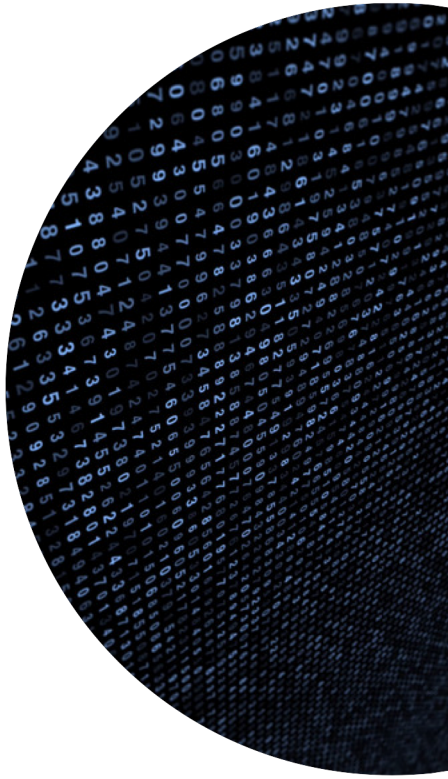


The essence of abstractions is preserving information that is relevant in a given context, and forgetting information that is irrelevant in that context.

– John V. Guttag

We assign the value 1 to the variable 'one'.
Now we can continue working with the variable 'one'.
Advantage: We are independent of concrete value

Numbers in Python



Integer

Integer:

- int (signed integers) – They are often just called integers or ints, are positive or negative whole numbers with no decimal point.

```
iOne = 1
```

Integer Action

Integer:

- Create two variables 'iOne' and 'iTwo'. Assign the values 2 and 5 to each of these variables.
- Perform the following operations with the variables:
  - iMulti is the multiplication of the two variables.
  - iAdd is the addition of the two variables.
  - iSub is the subtraction of the two variables. Started with iOne.
  - iDiff is the division of iOne by iTwo.

Integer Action

```
iMulti = iOne * iTwo
print(iMulti)

#iAdd is the addition of the two variables.
iAdd = iOne + iTwo
print(iAdd)

# iSub is the subtraction of the two variables. Started with iOne.
iSub = iOne - iTwo
print(iSub)

# iDiff is the division of iOne by iTwo.
iDiff = iOne / iTwo
print(iDiff)
```

Introduction to Primitive Data Types

Float:

- Float (floating point real values, **double**) – Also called floats, they represent real numbers and are written with a decimal point dividing the integer and fractional parts. Floats may also be in scientific notation, with E or e indicating the power of 10.
- Lets see how we can use float in python code.

```
dNumber = 1.0
```

Float Action

Integer:

- Create two variable ‘dOne' and ‘dTwo'. Assign the values 2.5 and 5.5 to each of these variables.
- Perform the following operations with the variables:
  - dMulti is the multiplication of the two variables.
  - dAdd is the addition of the two variables.
  - dSub is the subtraction of the two variables. Started with dOne.
  - dDiff is the division of dOne by dTwo.

Float Action

```
# dMulti is the multiplication of the two variables.
dMulti = dOne * dTwo
print(dMulti)

#dAdd is the addition of the two variables.
dAdd = dOne + dTwo
print(dAdd)

# dSub is the subtraction of the two variables. Started with dOne.
dSub = dOne - dTwo
print(dSub)

# dDiff is the division of dOne by dTwo.
dDiff = dOne / dTwo
print(dDiff)
```

Symbols in Python

Chars

Char:

- Chars are symbols!
- Char is short for character.
- All characters in all languages can be represented. This representation is in the **Unicode** format.
- Unicode is a computer encoding methodology that assigns a unique number for every character. It doesn't matter what language or computer platform it's on.
- Lets look at a new script!

Strings are missing!

U+000B		11	<control>
U+000C		12	<control>
U+000D		13	<control>
U+000E		14	<control>
U+000F		15	<control>
U+0010		16	<control>
U+0011		17	<control>
U+0012		18	<control>
U+0013		19	<control>
U+0014		20	<control>
U+0015		21	<control>
U+0016		22	<control>
U+0017		23	<control>
U+0018		24	<control>
U+0019		25	<control>
U+001A		26	<control>
U+001B		27	<control>
U+001C		28	<control>
U+001D		29	<control>
U+001E		30	<control>
U+001F		31	<control>
U+0020		32	SPACE
U+0021	!	33	EXCLAMATION MARK
U+0022	"	34	QUOTATION MARK
U+0023	#	35	NUMBER SIGN
U+0024	$	36	DOLLAR SIGN
U+0025	%	37	PERCENT SIGN
U+0026	&	38	AMPERSAND
U+0027	'	39	APOSTROPHE
U+0028	(	40	LEFT PARENTHESIS
U+0029	)	41	RIGHT PARENTHESIS
U+002A	*	42	ASTERISK
U+002B	+	43	PLUS SIGN
U+002C	,	44	COMMA
U+002D	-	45	HYPHEN-MINUS
U+002E	.	46	FULL STOP
U+002F	/	47	SOLIDUS
U+0030	0	48	DIGIT ZERO
U+0031	1	49	DIGIT ONE
U+0032	2	50	DIGIT TWO
U+0033	3	51	DIGIT THREE
U+0034	4	52	DIGIT FOUR
U+0035	5	53	DIGIT FIVE
U+0036	6	54	DIGIT SIX
U+0037	7	55	DIGIT SEVEN
U+0038	8	56	DIGIT EIGHT
U+0039	9	57	DIGIT NINE
U+003A	:	58	COLON

A unique number for every character.

- Try to get the unique number of ‘A’ as Unicode.

A unique number for every character.

- Try to get the unique number of ‘A’ as Unicode.

```
print(ord(char))
```

From Chars to Strings

- Springs are a sequence of chars.
- We can create them simply by enclosing characters in quotes. “Hello World” is a String!
- Therefore strings in Python are bytes representing Unicode characters.
- **In Detail:** Python does not have a character data type, **a single character is simply a string with a length of 1**.

Create two string variables

- Create two string variables:
  - sWordOne = 'I Love’
  - sWordTwo = 'data’
- Let's try to build a sentence with these two variables

Concatenated string

```
# Concatenated string
sWordOne = 'I Love'
sWordTwo = 'data'
sStatement = sWordOne + ' ' + sWordTwo
print(sStatement)
```

Built-in String Methods

- Python has a set of built-in methods that you can use on strings.

- How often does the word love appear in this sentence?

Note:
All string methods returns new values. They do not change the original string.

Outlook: What functions are we will learn later in detail!

Here are just a few useful string operations for now!

Built-in String Methods – Count()

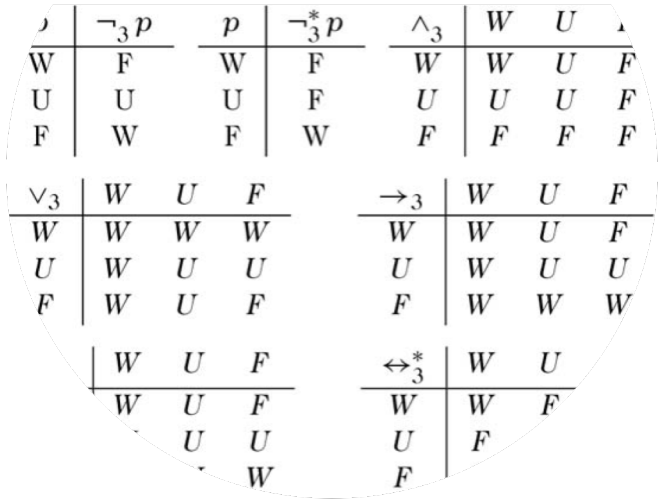
```
iCountSubStrings = sStatement.count('Love')
print(iCountSubStrings)
```

Lower Case

- I would like to write everything in lower case
- Do I have to rewrite everything now?
- No, thanks to Built-in Methods

Built-in String Methods – lower()

```
sStatementLower = sStatement.lower()
print(sStatementLower)
```



$\neg_3 p$	
W	F
U	U
F	W

p	$\neg_3^* p$
W	F
U	F
F	W

$\wedge_3$	W	U	F
W	W	U	F
U	U	U	F
F	F	F	F

$\vee_3$	W	U	F
W	W	W	W
U	W	U	U
F	W	U	F

$\rightarrow_3$	W	U	F
W	W	U	F
U	W	U	U
F	W	W	W

	W	U	F
W	W	U	F
U	U	U	
F	W		

$\leftrightarrow_3^*$	W	U
W	W	F
U	F	
F		

Boolean

Boolean and logical operators

- Boolean variable
- In computer science, the Boolean data type is a data type that has one of two possible values
- They are used to represent truth values (false or true).
- They are helpful for logical operations.

```
bBoolean = True
```

Logical operations

- We can perform logical operations with True and False
- Let's try it: Execute all combinations with True and False with **and-operation**
- Tip: 2^2 possible combinations

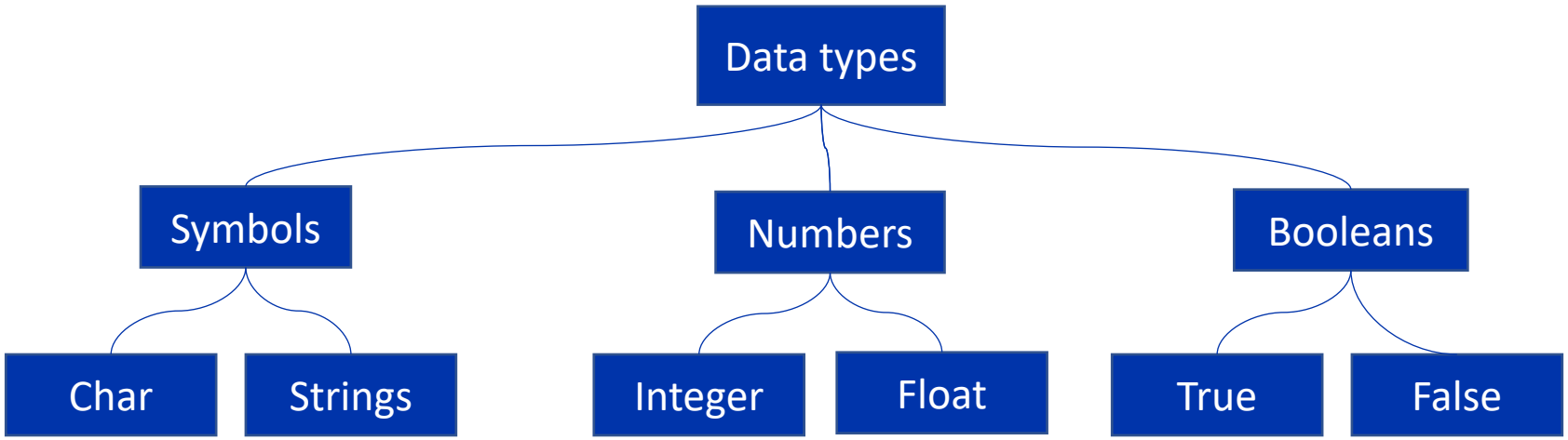
Logical operations

```
bTrue = True
bFalse = False
print(bTrue)
print('True and True is:', bTrue and bTrue)
print('False and False is:', bFalse and bFalse)
print('True and False is:', bTrue and bFalse)
print('True and False is:', bTrue and bFalse)
```

* For the sake of completeness: or is also a operator for True and False.

Introduction to Primitive Data Types

- Systematization of primitive data types



Formalities

Documentation

- Source Code Documentation
- @author: name
- @since: first implementation date
- @version: date of last update
- @source: if you using links etc.
- @code: special code note
- @param: if special parameter is used or you have to describe.

```
# I am a comment
@author: unknown
@since: 20190929
@version: beta1
print('Hello World')
```

Naming convention

- Names of attributes, variables, methods start with a small letter
  - may use letters without ß or similar
  - which points to the data type like i, s or l
- This is standard in professional software development
- Camel Case: Compound words are written in programming language. Every new word is capitalized

- Name = Is the name of…
- bScriptName = Simple code file that does something
- CName = Class (later more)
- dName = Variable that saves a floating point (double)
- iName = Variable that saves an integer value
- sName = Variable that saves a string value
- bName = Boolean for true or false values
- LName = Object from type list
- fName = Self-written function

Naming convention and comments

- Names of attributes, variables, methods start with a small letter
  - may use letters without ß or similar
  - which points to the data type like i, s or l
- This is standard in professional software development.
- Camel Case: Compound words are written in programming language. Every new word is capitalized.

https://www.python.org/dev/peps/pep-0008/

Naming convention, but python ...

for everything related to Python's style guide: i'd recommend you read PEP8.

175

To answer your question:

> Function names should be lowercase, with words separated by underscores as necessary to improve readability.

[12]

https://www.python.org/dev/peps/pep-0008/

Code is some kind of Art. Therefore…

But we are using the presented naming convention

These are all approaches. Find your own style!