Organizational matters
oooooo

What is Programming?
ooooooo

Overview of Python
ooooooo

Programming: Introduction

Alexander Schönhuth

UNIVERSITÄT BIELEFELD

Faculty of Technology

Bielefeld University
November 4, 2020

Organizational matters
oooooo

What is Programming?
ooooooo

Overview of Python
ooooooo

WHO ARE WE?

- ▶ Research group "Genome Data Science"
  https://gds.techfak.uni-bielefeld.de
- ▶ Prof. Dr. Alexander Schönhuth
  email: aschoen@cebitec.uni-bielefeld.de
  office: UHG U10-128
- ▶ Maren Knop
  email: mknop@cebitec.uni-bielefeld.de
  office: UHG U10-133

Organizational matters
○○○○○○

What is Programming?
○○○○○○○

Overview of Python
○○○○○○○

Organizational matters

What is Programming?

Overview of Python

Python Basics

ORGANIZATIONAL MATTERS

▶ Course prerequisites: *none*
▶ Coursework
  ▶ Weekly exercises
    ▶ Submission in groups of 2-3
    ▶ Upload to corresponding assignment in the
      "LernraumPlus": https://lernraumplus.
      uni-bielefeld.de/course/view.php?id=7725
    ▶ Excercise sheets will be provided after the lecture, on
      Wednesdays, 16:00
    ▶ Submission deadline is every **Tuesday 23:59**
  ▶ Written exam on **Wed. February 10, 2021 14:00-16:00,
    location TBD**
    ▶ Admitted: everyone exceeding 50% of total exercise points
▶ Lecture part of module *39-Inf-Pro "Programming"*, study
  program *Data Science*

UNIVERSITÄT
BIELEFELD

Organizational matters   What is Programming?   Overview of Python

●○○○○○   ○○○○○○○   ○○○○○○○

ORGANIZATIONAL MATTERS

- ▶ Course prerequisites: *none*
- ▶ Coursework
  - ▶ Weekly exercises
    - ▶ Submission in groups of 2-3
    - ▶ Upload to corresponding assignment in the "LernraumPlus": `https://lernraumplus.uni-bielefeld.de/course/view.php?id=7725`
    - ▶ Excercise sheets will be provided after the lecture, on **Wednesdays, 16:00**
    - ▶ Submission deadline is every **Tuesday 23:59**
  - ▶ Written exam on **Wed. February 10, 2021 14:00-16:00, location TBD**
    - ▶ Admitted: everyone exceeding 50% of total exercise points
- ▶ Lecture part of module *39-Inf-Pro "Programming"*, study program *Data Science*

UNIVERSITÄT
BIELEFELD

ORGANIZATIONAL MATTERS

- ▶ Course prerequisites: *none*
- ▶ Coursework
    - ▶ Weekly exercises
        - ▶ Submission in groups of 2-3
        - ▶ Upload to corresponding assignment in the "LernraumPlus": `https://lernraumplus.uni-bielefeld.de/course/view.php?id=7725`
        - ▶ Excercise sheets will be provided after the lecture, on **Wednesdays, 16:00**
        - ▶ Submission deadline is every **Tuesday 23:59**
    - ▶ Written exam on **Wed. February 10, 2021 14:00-16:00, location TBD**
        - ▶ Admitted: everyone exceeding 50% of total exercise points
- ▶ Lecture part of module *39-Inf-Pro "Programming"*, study program *Data Science*

UNIVERSITÄT
BIELEFELD

Organizational matters   What is Programming?   Overview of Python

○●○○○○   ○○○○○○○   ○○○○○○○

COURSE MATERIAL

- ▶ ... available on course website:
  https://gds.techfak.de/teaching/2020winter/prog
  - ▶ Slides and pointers to literature
  - ▶ Exercise sheets
- ▶ ... available in Lernraum Plus:
  https://lernraumplus.uni-bielefeld.de/course/view.
  php?id=7725
  - ▶ e-Learning Videos
  - ▶ Exercise sheets
  - ▶ Pointers to literature
  - ▶ Forum
  - ▶ **Weekly submission of exercise solutions**

Organizational matters
○○●○○○

What is Programming?
○○○○○○○

Overview of Python
○○○○○○○

LECTURES

▶ Video will be provided every

Wednesday, 16:00

▶ Video contents are discussed

Wednesday thereafter, 14:15 - 15:45

▶ ZOOM meeting:
https://uni-bielefeld.zoom.us/j/94847580461?pwd=
bDBPVFpRR2lReVZsY0J6ditndm9hZz09

▶ Lectures are question-answer rounds, arranged in small groups (via breakout rooms)

UNIVERSITÄT
BIELEFELD

TUTORIALS

▶ Every

Thursday, 10:15-11:45

▶ ZOOM meeting:
  https://uni-bielefeld.zoom.us/j/7524675886?
  pwd=SmpIdDQycEp0L0hZUHBLclA3V1A2UT09

▶ Discussion of exercise solutions

▶ You will present solutions to your classmates

UNIVERSITÄT
BIELEFELD

Organizational matters
○○○○●○

What is Programming?
○○○○○○○

Overview of Python
○○○○○○○

LITERATURE

- ▶ VanderPlas, Jake. (2016). *Python data science handbook.* Beijing; Boston; Farnham; Sebastopol; Tokyo: O'Reilly.
- ▶ Toomey, Dan. (2017). *Jupyter for data science.* Birmingham; Mumbai: Packt.
- ▶ Ana Bell, Eric Grimson, John Guttag (2016) *MIT 6.0001 Introduction to Computer Science and Programming in Python*: `http://ocw.mit.edu/6-0001F16`
- ▶ Eric Grimson, John Guttag, Ana Bell (2016) *MIT 6.0002 Introduction to Computational Thinking and Data Science*: `http://ocw.mit.edu/6-0002F16`

UNIVERSITÄT
BIELEFELD

Organizational matters
○○○○○●

What is Programming?
○○○○○○○

Overview of Python
○○○○○○○

COURSE SYLLABUS

Part 1

► Programming basics and terminology

► Introduction to Python

Part 2

► Scientific Programming

► Data Science with Python

Organizational matters
○○○○○○

What is Programming?
●○○○○○○

Overview of Python
○○○○○○○

Organizational matters

What is Programming?

Overview of Python

Python Basics

Organizational matters
000000

What is Programming?
0●00000

Overview of Python
0000000

WHAT IS A PROGRAMMING LANGUAGE?

- ▶ Natural vs. programming language
- ▶ Human-readable vs. machine-readable

Organizational matters
oooooo

What is Programming?
oo●oooo

Overview of Python
oooooooo

SYNTAX AND SEMANTICS

Syntax

Symbols, words, sentences

Semantics

Meaning behind symbols, words, and sentences

e.g. English:

- Words: He, She, It, Program,
  . . .
- Sentence grammar rule:
  Subject + Verb + Object

```
She loves Python         ✔        She loves Python         ✔
The house table the cup  ✘
The table reads the cup  ✔        The table reads the cup  ✘
```

UNIVERSITÄT
BIELEFELD

Organizational matters
000000

What is Programming?
000●000

Overview of Python
0000000

SYNTAX AND SEMANTICS

Syntax

Symbols, words, sentences

Semantics

Meaning behind symbols, words, and sentences

e.g. English:

- Words: He, She, It, Program, ...
- Sentence grammar rule:
  Subject + Verb + Object

```
She loves Python          ✔          She loves Python          ✔
The house table the cup   ✘
The table reads the cup   ✔          The table reads the cup   ✘
```

UNIVERSITÄT
BIELEFELD

Organizational matters
oooooo

What is Programming?
oo●oooo

Overview of Python
ooooooo

SYNTAX AND SEMANTICS

Syntax

Symbols, words, sentences

Semantics

Meaning behind symbols, words, and sentences

e.g. English:

- Words: `He`, `She`, `It`, `Program`, . . .
- Sentence grammar rule:
  Subject + Verb + Object

```
She loves Python            ✔          She loves Python            ✔
The house table the cup ✘
The table reads the cup ✔              The table reads the cup ✘
```

Organizational matters
○○○○○○

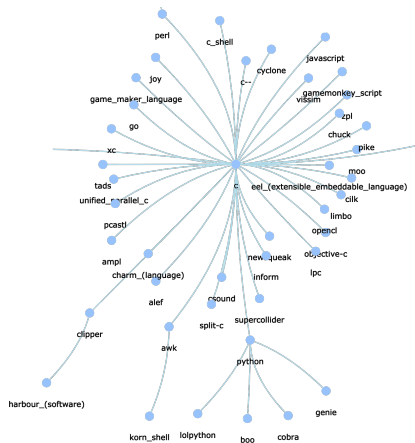What is Programming?
○○○○●○○○

Overview of Python
○○○○○○○

PROGRAMMING LANGUAGES . . .

▶ are formal languages with
unambiguous context-free
grammars,

syntactic ambiguity:
"Tom hit the man with a stick."

▶ offer different levels of
abstraction,

▶ change over time,

▶ inspire new generations of
languages.

High level language
- Easy to understand

OO and Visual Language

FORTRAN   C   Pascal

High-Level Language

Low level language
- Machine code
(processor instructions
and binary code)

Assembly Language

Machine Language

Hardware

Source:
`https://thebittheories.com`

PROGRAMMING LANGUAGES . . .

- ▶ are formal languages with
  unambiguous context-free
  grammars,

  syntactic ambiguity:
  "Tom hit the man with a stick."

- ▶ offer different levels of
  abstraction,

- ▶ change over time,
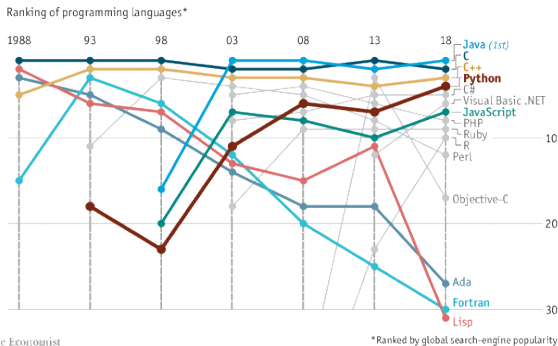
- ▶ inspire new generations of
  languages.

Source: http://svalver.github.
io/Proglang/paradigms.html

UNIVERSITÄT
BIELEFELD

Organizational matters
oooooo

What is Programming?
oooo●oo

Overview of Python
ooooooo

PROGRAMMING PARADIGMS

Many different general paradigms (notable excerpts):

- Imperative *– Do this, then do that!*
    - Procedural (C)
    - Object-oriented (C++, C#, Java)

- Declarative *– I want this, I want that!*
    - Logic (Prolog)
    - Functional (Haskell, Lisp)

- Mixed (Python, R)

There are also special-purpose languages (not necessarily considered "programming" languages), e.g. *LaTeX, HTML, XML.*

UNIVERSITÄT
BIELEFELD

LANGUAGE POPULARITY
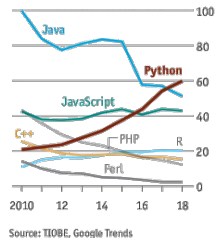
Source: Python is becoming the world's most popular coding language - The Economist (2018)

UNIVERSITÄT
BIELEFELD

Organizational matters
000000

What is Programming?
000000●

Overview of Python
0000000

QUIZ

- ▶ *Syntactic* or *semantic* ambiguity?

  - ▶ "Milk drinkers are turning to powder."
  - ▶ "Stolen painting found by tree."
  - ▶ "She went to her house, and so did Jane."

- ▶ *True* or *false*?

  - ▶ "All context-free grammars are unambiguous."
  - ▶ "Assembly language is a low level language."
  - ▶ "Functional programming is a form of imperative programming."

Organizational matters
000000

What is Programming?
0000000●

Overview of Python
0000000

QUIZ

- *Syntactic* or *semantic* ambiguity?
  - "Milk drinkers are turning to powder."   syntactic
  - "Stolen painting found by tree."   syntactic
  - "She went to her house, and so did Jane."   semantic

- *True* or *false*?
  - "All context-free grammars are unambiguous."   false
  - "Assembly language is a low level language."   true
  - "Functional programming is a form of imperative programming."   false

UNIVERSITÄT
BIELEFELD

Organizational matters

What is Programming?

Overview of Python

Python Basics

Organizational matters
000000

What is Programming?
0000000

Overview of Python
0●00000

PYTHON

Originally developed by Guido van Rossum in the late 1980s.

▶ Open-source and actively maintained

▶ Applicable to a wide range of applications

▶ Extremely popular in the data science community

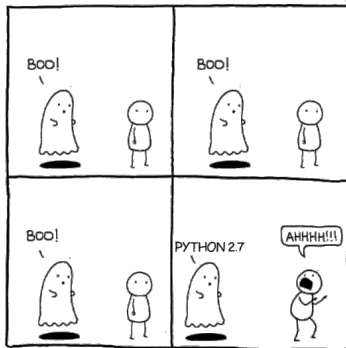But: There are alternative programming languages. Make sure to use the right one for the task.

Guido van Rossum, source: https://gvanrossum. github.io, ©Michael Cavotta, license: CC BY-NC-ND 4.0

UNIVERSITÄT
BIELEFELD

Organizational matters
oooooo

What is Programming?
ooooooo

Overview of Python
oo●oooo

WHICH PYTHON VERSION?

- Python 2: still common, although no longer maintained

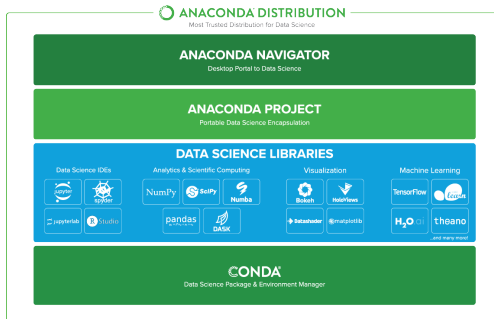- Python 3: modernized, *backwards-incompatible* version of the language

source:
https://www.reddit.com/r/
ProgrammerHumor/comments/
91vtas/python_27/

UNIVERSITÄT
BIELEFELD

Organizational matters
○○○○○○

What is Programming?
○○○○○○○

Overview of Python
○○○●○○○○

DEVELOPMENT ENVIRONMENT: ANACONDA

Python Data Science Distribution

DOWNLOAD ANACONDA

https://www.anaconda.com/distribution#
download-section

Organizational matters
○○○○○○

What is Programming?
○○○○○○○

Overview of Python
○○○○○●○○

ANACONDA NAVIGATOR

Organizational matters
000000

What is Programming?
0000000

Overview of Python
000000●

QUIZ

▶ *True* or *false*?

  ▶ "Python has been developed for data science analysis."
  ▶ "Python is the only language used in data science analysis."
  ▶ "The university has bought Python licenses for this course."

UNIVERSITÄT
BIELEFELD

Organizational matters
oooooo

What is Programming?
ooooooo

Overview of Python
oooooo●

QUIZ

- *True* or *false*?

    - "Python has been developed for data science analysis."   false
    - "Python is the only language used in data science analysis."   false
    - "The university has bought Python licenses for this course."   false