Programming: Introduction

Harsha Manjunath

UNIVERSITÄT BIELEFELD
Faculty of Technology

Bielefeld University
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Who are we?

- Research group “Genome Data Science”
  `https://gds.techfak.uni-bielefeld.de`
- Harsha Manjunath
  email: harsha.manjunath@uni-bielefeld.de
  office: UHG U10-121

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=15556
    - Excercise sheets will be provided after the lecture, on **Wednesdays, 16:00**
    - Submission deadline is every **Tuesday 23:59**
  - Written exam on **Wed. February 8, 2023 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*

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Course material

- . . . available on course website:
  https://gds.techfak.de/teaching/2022winter/prog
  - Slides and pointers to literature
  - Exercise sheets
- . . . available in Lernraum Plus:
  `https://lernraumplus.uni-bielefeld.de/course/view.php?id=15556`
  - e-Learning Videos
  - Exercise sheets
  - Pointers to literature
  - Forum
  - **Weekly submission of exercise solutions**

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/62307398783?pwd=RG9UTnYxdTFEZklSelJHaG1mZTdwUT09`

Tutorials

- Every

  Thursday, 10:15-11:45

- ZOOM meeting:

  `https://uni-bielefeld.zoom.us/j/61222618442?pwd=OVJFVFpsRmNhR2QxVldodVF3WlFiQT09`

- Discussion of exercise solutions
- You will present solutions to your classmates

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`

Course syllabus

Part 1

- Programming basics and terminology
- Introduction to Python

Part 2

- Scientific Programming
- Data Science with Python

Organizational matters

What is Programming?

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Python Basics

What is a programming language?

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

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` ✗

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`The house table the cup` ✘	
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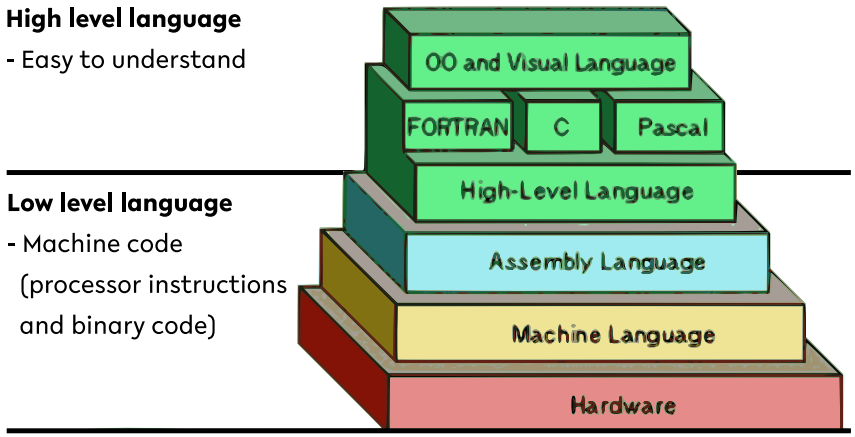
Programming languages . . .

- 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:
`https://thebittheories.com`

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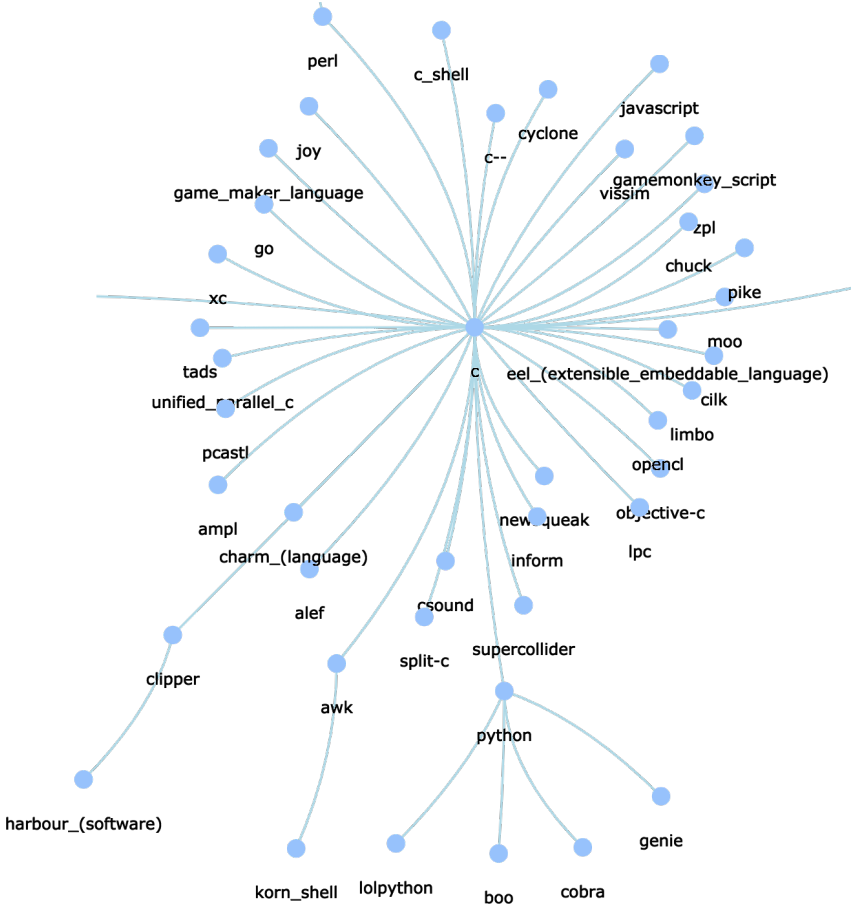


Source: `http://svalver.github.io/Proglang/paradigms.html`

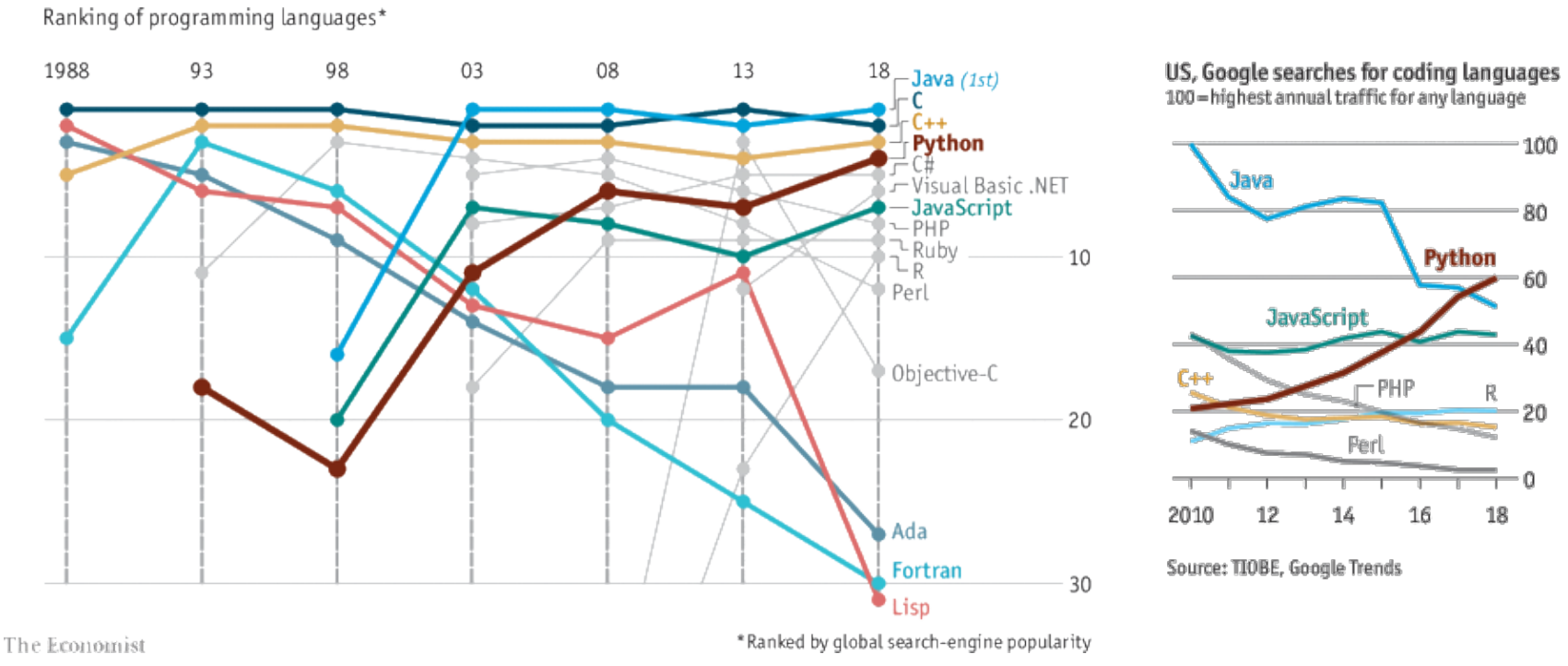
Programming paradigms

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*.

Language popularity



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

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."

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

Organizational matters

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Python

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

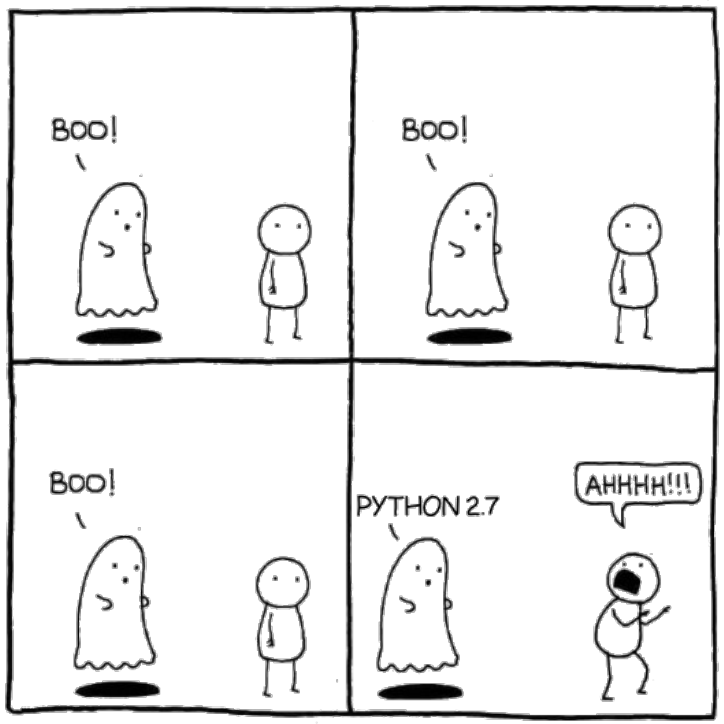
- Open-source and actively maintained
- Applicable to a wide range of applications
- Extremely popular in the data science community

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

Which Python version?

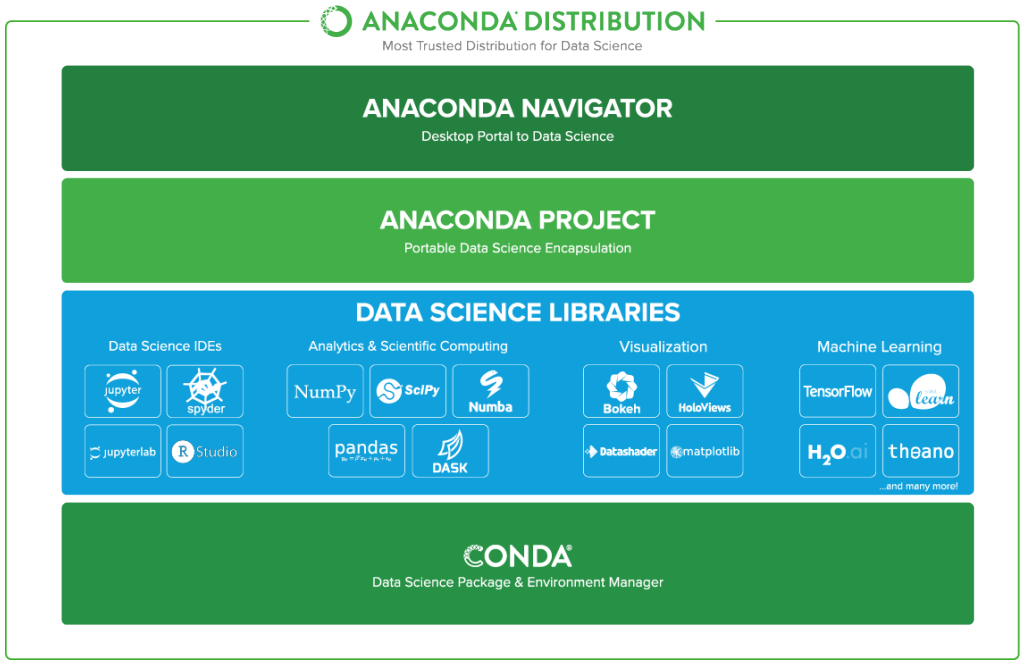
- Python 2: still common, although no longer maintained
- Python 3: modernized, *backwards-incompatible* version of the language



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

Development environment: Anaconda

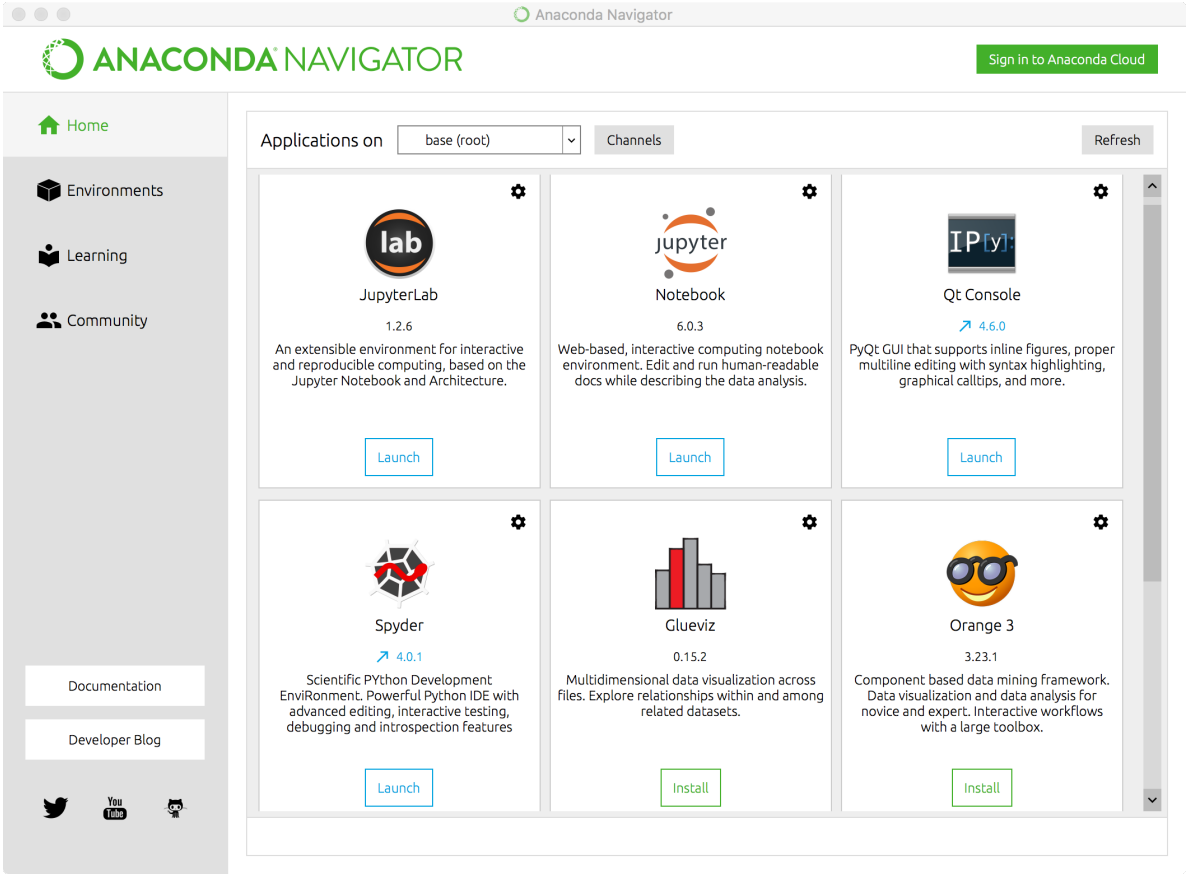
Python Data Science Distribution



Download Anaconda

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

Anaconda navigator



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."

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