

Recap

During our last lecture we talked about:

- ❖ Organization of the course
- ❖ What is a programming language
- ❖ What is ChatGPT
- ❖ Building programs with Scratch

***Computer
architecture***

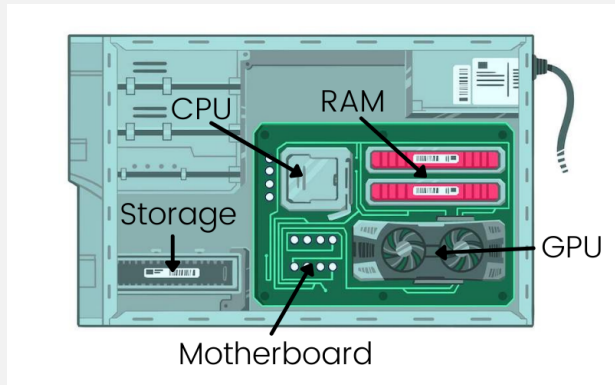
***Overview of
Python***

***Anaconda,
Qt Console,
& Jupyter***

Python Basics

What is a computer?

- ❖ A computer is an electronic machine that can process and store information
- ❖ It executes tasks by running the instructions stored in its memory
- ❖ Computers do not *understand*

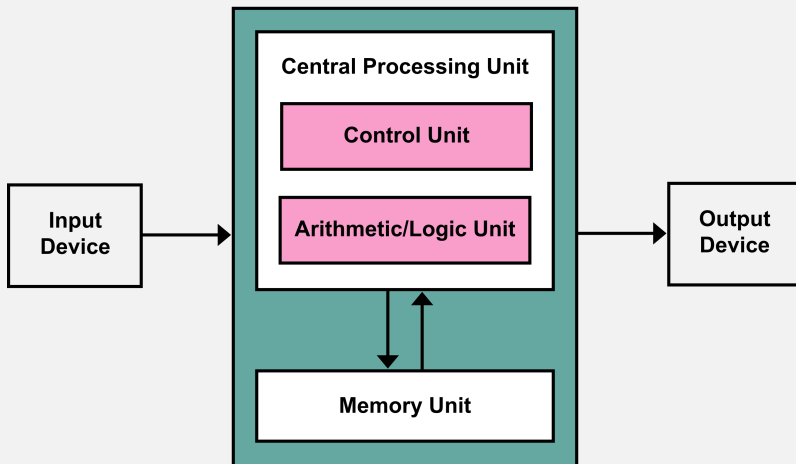


What's inside a computer, source: <https://tinyurl.com/5n7ayzew>

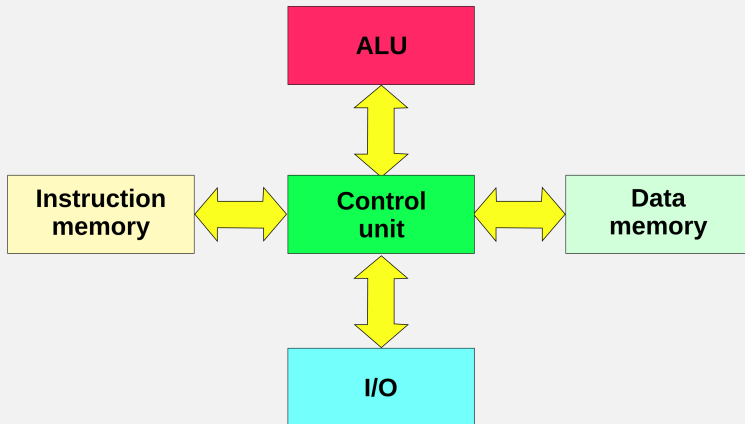
Computer architecture

- ❖ The description of the structure of a computer system made from component parts
- ❖ The parts interact with each other to help the computer execute instructions

Computer architecture - Von Neumann's style



Computer architecture - Harvard's style



Compiler vs Interpreter

Compiler

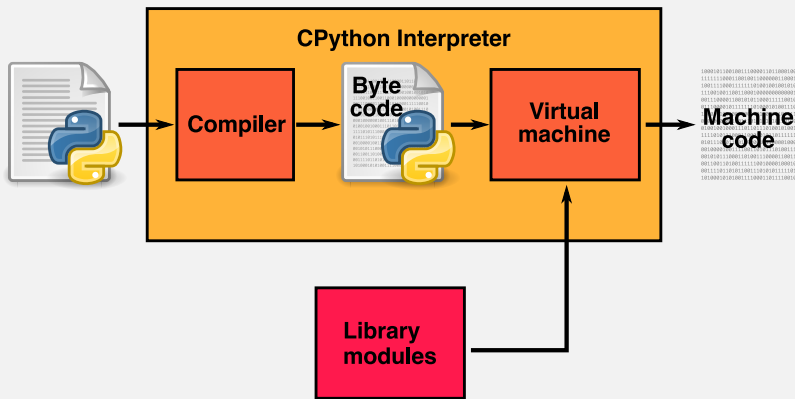
- ❖ “Translates” the whole source code at once
- ❖ Compiling is slower
- ❖ Compiled code runs faster

Interpreter

- ❖ “Translates” the source code one line at a time
- ❖ Interpreting is faster
- ❖ Interpreted code runs slower

What about Python?

Python, as other programming languages, is not fully interpreted nor fully compiled:



***Computer
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Python Basics

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

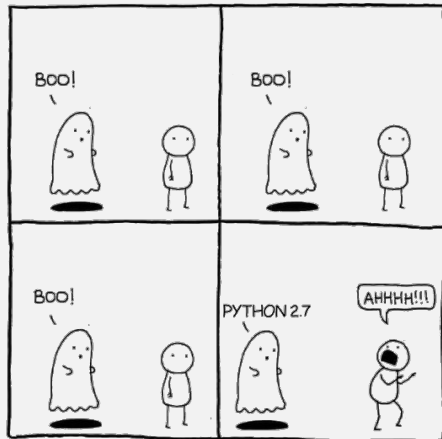
But: There are alternative programming languages.
Make sure to use the right one for the task.



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

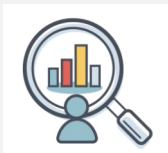
Which Python version?

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

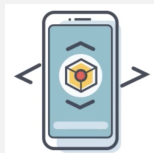


source: https://www.reddit.com/r/ProgrammerHumor/comments/91vtas/python_27/

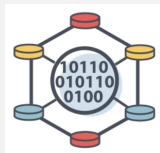
Why Python?



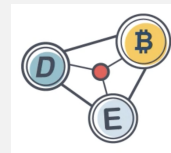
Data analysis



Web scraping



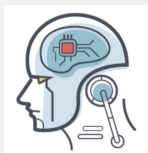
Big data



Finance



Computer vision



NLP



Machine learning



Deep learning

***Computer
architecture***

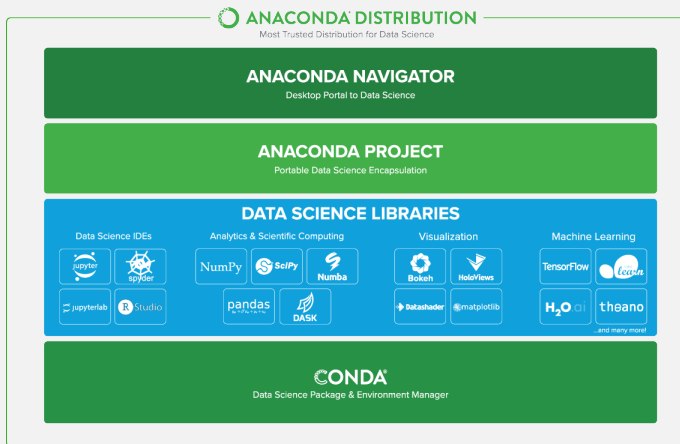
***Overview of
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Python Basics

Development environment: Anaconda

Python Data Science Distribution



Download Anaconda

Download Now

For installation assistance, refer to [Troubleshooting](#).

Download Anaconda Distribution or [Miniconda](#) by choosing the proper installer for your machine. Learn the difference from our [Documentation](#).



Anaconda Installers

Download for Mac



Windows

Python 3.12

64-Bit Graphical Installer (912.3M)



Mac

Python 3.12

64-Bit (Apple silicon) Graphical Installer (704.7M)

64-Bit (Apple silicon) Command Line Installer (707.3M)

64-Bit (Intel chip) Graphical Installer (734.7M)

64-Bit (Intel chip) Command Line Installer (731.2M)



Linux

Python 3.12

64-Bit (x86) Installer (1007.9M)

64-Bit (AWS Graviton2 / ARM64) Installer (800.6M)

64-bit (Linux on IBM Z & LinuxONE) Installer (425.8M)

<https://www.anaconda.com/download/success>

Anaconda navigator

The screenshot displays the Anaconda Navigator desktop application. The interface is divided into a left sidebar and a main content area. The sidebar contains navigation options: Home, Environments, Learning, and Community. The main content area shows a grid of application cards for the 'base (root)' environment. Each card includes an icon, the application name, version number, a brief description, and a button to either 'Launch' or 'Install' the application. A 'Sign in to Anaconda Cloud' button is visible in the top right corner.

ANACONDA NAVIGATOR

Sign in to Anaconda Cloud

Applications on base (root) Channels Refresh

Application	Version	Action
JupyterLab	1.2.6	Launch
Jupyter Notebook	6.0.3	Launch
Qt Console	4.6.0	Launch
Spyder	4.0.1	Launch
Glueviz	0.15.2	Install
Orange 3	3.23.1	Install

JupyterLab
1.2.6
An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.
Launch

Jupyter Notebook
6.0.3
Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis.
Launch

Qt Console
4.6.0
PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.
Launch

Spyder
4.0.1
Scientific Python Development Environment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features.
Launch

Glueviz
0.15.2
Multidimensional data visualization across files. Explore relationships within and among related datasets.
Install

Orange 3
3.23.1
Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox.
Install

Documentation
Developer Blog

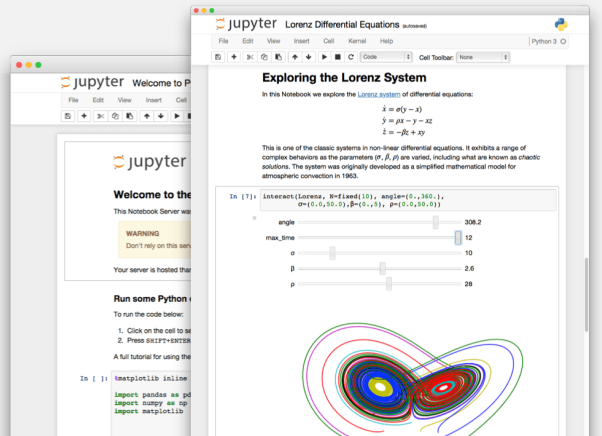
Twitter YouTube GitHub

Jupyter Notebook

The Jupyter Notebook is a web-based interactive computing platform.

Why use Jupyter Notebook in Data Science?

- ❖ Simultaneous documentation & analysis
- ❖ Step-by-step processing
- ❖ Ensures reproducibility



<https://docs.jupyter.org/en/latest/>

Launching Python

The screenshot displays the Anaconda Navigator desktop application. The interface includes a sidebar on the left with navigation options: Home, Environments, Learning, and Community. The main area shows a grid of application cards for 'base (root)' channel. The cards are:

- JupyterLab 1.2.6**: An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture. [Launch](#)
- Jupyter Notebook 6.0.3**: Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis. [Launch](#)
- Qt Console** (highlighted in red): IPython Qt Console. PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more. [Launch](#)
- Spyder 4.0.1**: Scientific Python Development Environment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features. [Launch](#)
- Glueviz 0.15.2**: Multidimensional data visualization across files. Explore relationships within and among related datasets. [Install](#)
- Orange 3 3.23.1**: Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox. [Install](#)

At the top right of the application window, there is a 'Sign in to Anaconda Cloud' button. The top of the main area shows 'Applications on base (root)' and 'Channels' tabs, along with a 'Refresh' button.

Launching Python

The screenshot displays the Anaconda Navigator application window. The title bar reads "Anaconda Navigator". The main header features the "ANACONDA NAVIGATOR" logo and a "Sign in to Anaconda Cloud" button. A left sidebar contains navigation options: Home, Environments, Learning, and Community. Below the sidebar are buttons for "Documentation" and "Developer Blog", and social media icons for Twitter, YouTube, and GitHub. The main content area is titled "Applications on base (root)" and includes a "Channels" tab and a "Refresh" button. A "Jupyter QtConsole" window is open, showing the following text:

```
Jupyter QtConsole 4.6.0
Python 3.7.6 (default, Jan 8 2020, 13:42:34)
Type 'copyright', 'credits' or 'license' for more information
IPython 7.12.0 -- An enhanced Interactive Python. Type '?' for help.

In [1]:
```

Below the console, there are three cards with descriptions and buttons:

- Scientific Python Development Environment:** Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features. [Launch](#)
- Multidimensional data visualization across files:** Explore relationships within and among related datasets. [Install](#)
- Component based data mining framework:** Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox. [Install](#)

At the bottom of the main content area, it says "Launching qtconsole" next to a blue progress bar.

Launching Python

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Jupyter QtConsole 4.6.0
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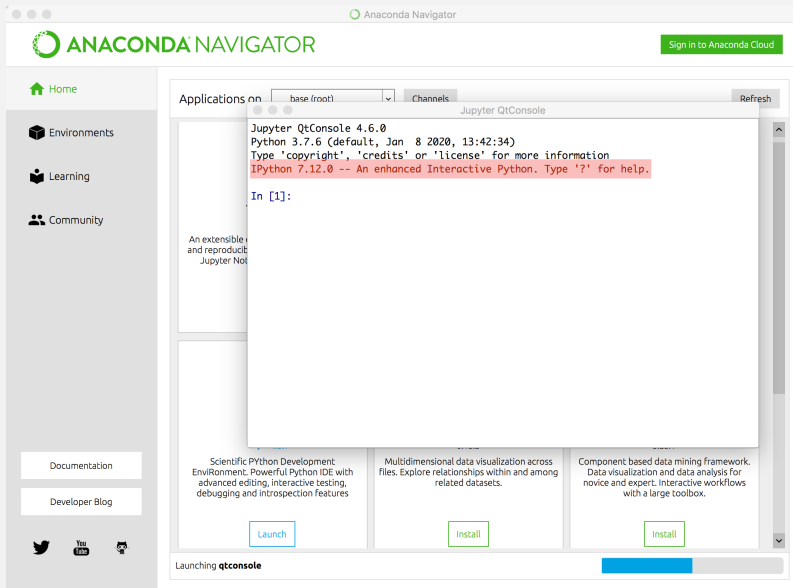
In [1]:
```

Below the console, there are three cards for different Python environments:

- Scientific Python Development Environment:** Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features. [Launch](#)
- Multidimensional data visualization:** Explore relationships within and among related datasets. [Install](#)
- Component based data mining framework:** Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox. [Install](#)

At the bottom of the console area, it says "Launching qtconsole" with a blue progress bar.

Launching Python



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Type 'copyright', 'credits' or 'license' for more information
Python 7.12.0 -- An enhanced Interactive Python. Type '?' for help.

In [1]:
```

Below the console, there are three cards for different Python environments:

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At the bottom of the interface, it says "Launching qtconsole" with a blue progress bar.

Quiz

❖ *True or false?*

- ❖ “Python is a low level programming language.”
- ❖ “Python is the only language used in data science analysis.”
- ❖ “The university has bought Python licenses for this course.”

Quiz

❖ *True or false?*

- ❖ “Python is a low level programming language.” false
- ❖ “Python is the only language used in data science analysis.” false
- ❖ “The university has bought Python licenses for this course.” false

***Computer
architecture***

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Python Basics

Arithmetic in Python

Numeric types:

- Integer: `int` 42
- Real valued numbers: `float` 42.0
- Complex numbers: `complex` 42+0j

Operators

- Addition and subtraction + -
- Multiplication and division * / // %
- Exponentiation **

Variables

Variable assignment

❖ `a = 42`

❖ `b = a - 6.0`

`type(«name of the variable»)`: returns type of variable

Libraries

Importing libraries

```
❖ import numpy as np
```

```
❖ import matplotlib.pyplot as plt
```

`import <<name of the library>>as <<alias>>`: loads the requested library under the alias' name

Quiz

❖ What are types numeric types of the following calculations?

- ❖ `type(42 / 3)`
- ❖ `type(42 // 3)`
- ❖ `type(3.14 + 2.71+8j)`
- ❖ `type(42 // 3.14)`
- ❖ `a = 1`
`a - 10 * 1.0`
`type(a)`

Quiz

❖ What are types numeric types of the following calculations?

- ❖ `type(42 / 3)` float
- ❖ `type(42 // 3)` int
- ❖ `type(3.14 + 2.71+8j)` complex
- ❖ `type(42 // 3.14)` float
- ❖ `a = 1`
`a - 10 * 1.0`
`type(a)` int

Python Documentation

The screenshot shows the Python documentation website. At the top left is the Python logo and the text "python™". To the right is a yellow "Donate" button, a search bar with a magnifying glass icon, a "GO" button, and a "Socialize" button. Below this is a navigation bar with tabs for "About", "Downloads", "Documentation", "Community", "Success Stories", "News", and "Events". The "Documentation" tab is active, and a dropdown menu is open, listing: "Docs", "Audio/Visual Talks", "Beginner's Guide", "Developer's Guide", "FAQ", "Non-English Docs", "PEP Index", "Python Books", and "Python Essays". A white search overlay is positioned over the "Docs" link, containing the text: "Python's standard documentation: download, browse or watch a tutorial." Below this text is a button labeled "Python Docs". On the left side of the page, a code block shows a Python shell session:

```
# Python 3: Simple arithmetic
>>> 1 / 2
0.5
>>> 2 ** 3
8
>>> 17 / 3 # classic division returns a float
5.666666666666667
>>> 17 // 3 # floor division returns the truncated integer
5
```

Recap

Summary

- ❖ Computer architecture
- ❖ Overview of Python
- ❖ Anaconda, Qt Console & Jupyter Notebooks
- ❖ First steps in Python

What comes next?

- ❖ Go to the course website
(<https://gds.techfak.de/teaching/2024winter/prog>) or Moodle (<https://moodle.uni-bielefeld.de/course/view.php?id=6494>) and download this week's exercise sheet
- ❖ Due date for this week's exercises is **Wednesday, October 23, 2024.**

Next lecture: Data types, mutability, conditions & comparisons ...